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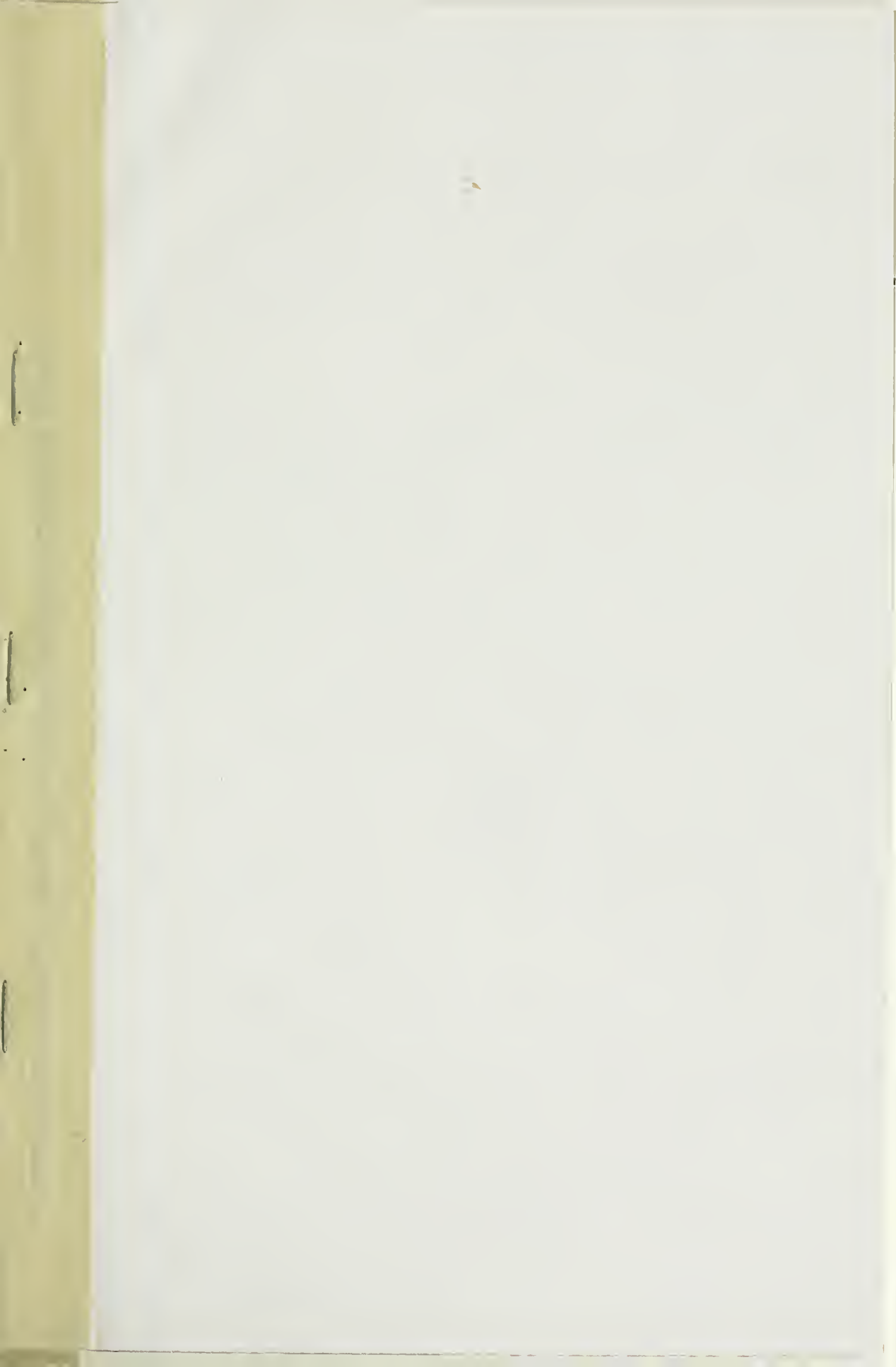
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Robert A. Evers.

Hill Prairies of Illinois.

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of the

ILLINOIS NATURAL HISTORY SURVEY

HARLOW B. MILLS, *Chief*

Hill Prairies
of Illinois

ROBERT A. EVERS



Printed by Authority of the
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This paper is a contribution from the Section of Applied Botany and Plant Pathology

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Grassy strips on the steep upper slopes of bluffs of the Mississippi River along Illinois highway 96 in northwestern Calhoun County. Grasslands on steep slopes are hill prairies. The hill prairie on the bluff in the foreground is south of Howell Hollow; the distant one is on the Clendenny farm.

Hill Prairies of Illinois*

ROBERT A. EVERS

ON the sunny, windswept, upper slopes of some of the bluffs along the major Illinois streams are treeless areas distinctive enough to attract the attention of observing travelers. These areas are grassy strips or grassy openings on the otherwise forested slopes of the bluffs, frontispiece. Most of them have been little disturbed by man or domesticated animals. Those that are covered with prairie plants are prairies.

Prairies are grasslands. To many persons, prairies are flat grasslands. However, it is not topography but vegetation that distinguishes prairies and other plant communities. Forests occur on flat land or on slopes. So do prairies. Grasslands, or prairies, on pronounced slopes are *hill prairies*.

The term *hill prairies* was first used in 1943 by a University of Illinois botanist, Dr. Arthur G. Vestal, in his ecology classes and seminars to characterize prairies that occur on loess bluffs, on mounds, on steep, rocky slopes, on steep slopes of glacial drift, or on any other steep slopes. With few exceptions, the hill prairies of Illinois are not hill-top prairies; most of them occupy only the upper west- and southwest-facing slopes of elevations.

Most of the once extensive flatland prairies have disappeared from the Illinois landscape. There yet remain a few patches of these prairies on the till plains, but they have been very much disturbed by man or domesticated animals. The prairies of the bottomlands, the type studied by Turner (1934a, 1934b), now occur only in small scattered patches, usually in field borders or borders of roadside ditches in the Mississippi and Illinois river valleys. There are still sizable areas of sand prairies of the type studied by Gleason (1910), Gates (1912), Vestal (1913),

and others, but the extent of these prairies is rapidly decreasing as a result of the activities of man in converting them to fields of watermelons or cantaloupes, or to another type of grassland, the cornfield.

There remain on the Illinois landscape numerous tracts of hill prairie and, as these prairie slopes were never plowed, they are now the least disturbed type of prairie in the state. Although rather complete studies of till plain, bottomland, and sand prairies of Illinois have been published, until this time no comparable study has been done for the hill prairies of this state.

Several studies have been published on the hill prairies of other states. The study by Bush (1895) on the mound flora of Atchison County, Missouri, and the work of Steyermark (1940) on succession in Ozark glades of the same state concerned, in part, prairie on pronounced slopes. Studies of Pammel (1896, 1899, 1902) and Shimek (1910a, 1910b, 1911, 1924) described the vegetation and enumerated the species of the loess bluff prairies in western Iowa or of the prairie openings or grassy meadows on the Iowa bluffs of the Mississippi River. Reports of Hanson (1922), of Costello (1931), and of Hopkins (1951) described prairies on loess bluffs along the Missouri River in Nebraska or prairies on loess hills in central Nebraska. A paper by Marks (1942) characterized what he termed the "goat prairies" of Wisconsin as prairies located on slopes "so steep that only the nimble goat could graze them." Sites described in these papers were prairies on steep slopes, or hill prairies.

Perhaps the earliest reference in the literature to Illinois grasslands on the upper slopes of bluffs is found in reports on the geology of Greene County and of Scott County by Worthen (1868). In these reports, Worthen described loess-capped bluffs with grass-covered knobs. These

*This article is based upon a thesis submitted by the writer to the Graduate College, University of Illinois, Urbana, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Botany.

grassy knobs were prairies on steep slopes, or hill prairies. It is surprising that no earlier descriptions of hill prairies are extant. Certainly the French settlers saw the grassy slopes and perhaps named the village of Prairie du Rocher (Prairie of the Rock) after the prairie above the cliffs. The capable botanist, André Michaux, who traveled from Kaskaskia to Cahokia and visited the village of Prairie du Rocher in 1795, apparently made no record, in that part of his journal included by Sargent (1889), of grasslands on the bluffs. Early gazetteers, as those of Peck (1834) and Ellsworth (1837), contain references to wet, dry, level, and undulating prairies, but apparently nothing about prairies on the bluffs. Short (1845) wrote a good description of the autumnal aspect of flatland prairies; his journey did not take him far enough to the west to include hill prairies.

Some references to hill prairies of Illinois have appeared in the past 50 years. Hus (1908) described the bluffs in the vicinity of Collinsville and mentioned open hillsides with grasses dominant and bluegrass the chief species. Vestal (1918) cited numerous prairie inclusions near Charleston, described their topography, and stated essential conditions for their presence. Woodard (1924) mentioned prairies on bluff-ridges. Vestal (1931) reported the occurrence of prairies on loess bluffs of the Mississippi River, and Vestal & Bartholomew (1941) briefly described some prairies on the loess bluffs of the Illinois River.

These authors were concerned only with local occurrences of hill prairies in Illinois. They did not report on the extent of hill prairies in the state, nor did they report in detail on the flora of the hill prairies, the characteristic plants, relative abundance, presence and space relations as determinable in plot studies, or the origin and history of hill prairies. In order to obtain the necessary information for a study of these characteristics of hill prairies and for a description of hill prairie vegetation in Illinois, the writer made numerous plant collections and plant identifications from 61 hill prairies, fig. 1, having a combined area of more than 200 acres. Detailed data pertaining to

the vegetation were obtained from two prairies by use of plot studies, as explained in a later section of this paper.

The locations of some hill prairies were determined by the writer from the field notes made by Dr. Vestal during his travels in the state; of others, as the prairie southeast of Menominee Station in Jo Daviess County, from a study of aerial photographs. The majority, however, were found by field reconnaissance of the writer. During late autumn and early spring, hill prairies can easily be seen from the roads near or at the bases of the bluffs. Such roads, called bluff roads on some maps, are common in both the Mississippi and Illinois river valleys. In the Mississippi River valley, bluff roads were traveled by the author from Olive Branch in Alexander County northward to a point north and west of Glen Carbon in Madison County and from Hamburg in Calhoun County the 275-mile distance to the northwest corner of the state, except for short gaps in Hancock, Henderson, Mercer, Rock Island, and Jo Daviess counties. In the lower Illinois River valley, bluff roads were traveled from Grafton to Hennepin, except for a few gaps in Mason and Tazewell counties. The locations of prairie sites were marked on maps of sufficient scale to be used easily.

Not all hill prairies seen were visited, nor were bluffs of small streams examined for occurrences of hill prairies. Doubtless small prairie openings occur on the bluffs of small streams in the western part of the state. In eastern Illinois, Vestal (1918) observed several prairie openings along the Embarrass River near Charleston.

ACKNOWLEDGMENTS

It is indeed a pleasure to acknowledge the assistance given by Dr. A. G. Vestal, Department of Botany, University of Illinois, in the preparation of this study. I wish to thank him for his willingness to direct this investigation and for the many helpful suggestions he made during its progress.

Dr. L. R. Tehon, now deceased, and Dr. H. B. Mills, of the Natural History Survey, greatly facilitated the progress of

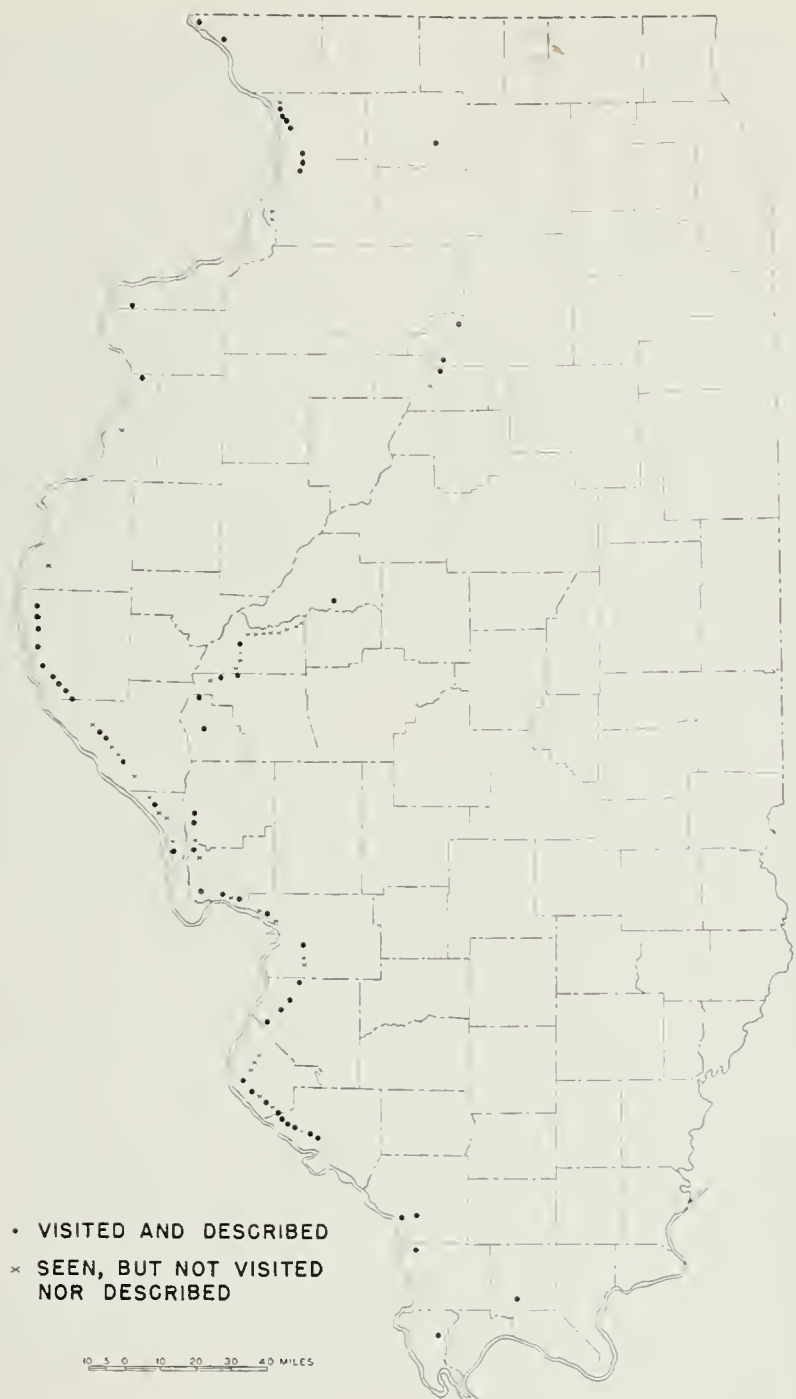


Fig. 1.—Location of the Illinois hill prairies which the author visited and of those which he saw only from a distance during the field work for this report. Hill prairies are most numerous on bluffs that trend northwest and southeast and have upper slopes facing the southwest. Bluffs of tributary streams were not examined for occurrences of hill prairies.

this study; for their help I am truly grateful.

Also, I wish to acknowledge here the assistance given by Mr. W. H. Phegley and Mr. J. J. Steibel of Prairie du Rocher, both of whom are now deceased. Some of the vegetation studies for this investigation were accomplished through their kind co-operation. I wish to thank Dr. G. W. White, Department of Geology, University of Illinois, and Dr. H. B. Willman and Dr. G. E. Ekblaw, Illinois State Geological Survey, for information concerning the geology of hill prairies; Mr. B. M. Woods, University Library Map Room, for his efforts to locate suitable aerial photographs; Mr. Julian Neill, East St. Louis, for assistance in the study of hill prairies in that region; Dr. J. L. Forsberg, Dr. P. F. Hoffman, Mr. J. W. Curfman, and Mr. R. E. Teegardin, while members of the Natural History Survey staff, for assistance with the statistics, the hydrogen-ion determinations, and the maps, diagrams, and drawings; and Mr. J. S. Ayars, also a Survey staff member, for his assistance with editorial problems.

Others I wish to thank for their contributions to this investigation are Dr. M. W. Sanderson, Dr. H. H. Ross, Dr. L. J. Stannard, Illinois Natural History Survey; Mr. and Mrs. F. W. Evers, Quincy; Mr. Raymond Hatcher, Murphysboro; Dr. J. W. Hall, University of Minnesota; Mr. and Mrs. B. C. Trees, East St. Louis; Frederick Evers, Clara V. Evers, and Marilyn Briggs Ellerman, Champaign; and Miss Virginia Frank, Chicago.

Mr. Dewey Clark, Quincy, took the pictures for the frontispiece and fig. 16. Mr. W. E. Clark, Natural History Survey staff, took the photographs used as figs. 3, 17, 18, 22, and 24. All other photographs were taken by the author.

The plant nomenclature used in this study is for the most part that of Hitchcock (1950) for grasses and Fernald (1950) for other plants. Where the nomenclature in this report does not conform to that in the manual of Hitchcock or that of Fernald, the manual name is included in brackets in the section on the flora of hill prairies. In instances in which

a name of long standing has been changed in recent manuals, the former name, in brackets, also appears. Common names not from the above manuals are from Deam (1940) or Jones (1950).

ENVIRONMENT

The occurrence and distribution of plants, and consequently plant communities, is determined largely by climate and other environmental conditions, including the soil or substratum in which they grow. Some of the environmental conditions favoring the existence of hill prairies in Illinois are discussed in the following sections.

The climate in practically any part of Illinois permits growth of either prairie or forest. The circumstances (aside from those of accident and of history) which tip the balance and thus determine the details of local distribution of prairie and forest are chiefly the controls exerted by topography.

Climate

The following information on climatic conditions applies to the Mississippi River valley along the western border of Illinois, the region of the majority of hill prairies observed for this report. With few exceptions, the climatic data, taken from Page (1949), are from weather stations located along the Mississippi River. Exceptions are the data from the Mount Carroll, Carbondale, Anna, and Greenville weather stations; these stations are, respectively, about 9, 11, 12, and 33 miles from the nearest hill prairies.

Temperature.—The average January temperature along the western border of Illinois varies from 19.6 degrees Fahrenheit in northwestern Illinois (Dubuque, Iowa, weather station) to 36.2 in southern Illinois at Cairo. The average July temperature is 74.6 degrees in northwestern, 80.2 in west-central (Quincy weather station), and 79.8 in southwestern and southern Illinois (St. Louis, Missouri, and Carbondale, Illinois, weather stations). In Cairo, at the southernmost weather station in Illinois, the average July temperature is 79.5 degrees. The re-



Fig. 2.—An excavation in the toe or basal slope of a bluff southwest of Renault, Monroe County, which shows the characteristics of the rock fragments that form the basal slopes of many river bluffs. The fragments have spalled from the cliff above the slope.

corded extremes of temperature are -35 degrees at Mount Carroll (January 22, 1930) and 115 degrees at Greenville (July, 1936). The highest recorded temperature in that part of Illinois along the Mississippi River is 114 degrees, recorded at Quincy in July, 1936.

Precipitation.—The average annual precipitation along the western border of Illinois varies from 33.13 inches in northwestern Illinois (Dubuque, Iowa, weather station) to 41.39 at Cairo and 47.43 at Anna. Averages of snowfall, notably less than 10 per cent of the annual precipitation, are 9.9 inches at Cairo and 32.3 at Mount Carroll. The wettest month in northern and west-central Illinois is June. The wettest month in southern Illinois varies with location; May is the wettest month at Anna, March the wettest at Cairo. During the growing season, April through September, Cairo receives 49.41 per cent of its annual rainfall; Anna, 52.77 per cent; Quincy, 65.26 per cent; and northwestern Illinois (Dubuque, Iowa, weather station), 66.77 per cent.

Frost.—The average frost-free periods along the western border of Illinois are April 19 to October 16 in northwestern Illinois (Dubuque, Iowa, weather station), April 13 to October 20 at Quincy in west-central Illinois, April 9 to October 26 at Anna, and March 30 to October 29 at Cairo.

Wind.—The prevailing wind in winter along the western border of Illinois is from the northwest; in summer, it is from the southwest, often hot and dry.

Physiography and Geology

Steep slopes or bluffs abut the broad, deeply alluviated floodplains or bottomlands of many of the major stream valleys in Illinois. The continuity of the bluffs is broken by tributary streams that enter the main valleys. The underlying bedrock and the surficial material determine the form of the bluffs.

The bedrock of the bluffs on which hill prairies occur is limestone, dolomite, sandstone, shale, or combinations of these; the geological ages of the uppermost strata range from Middle Ordovician to Upper

Pennsylvanian. In most places, the bedrock crops out to form a cliff as much as 200 feet above the valley floor. Frequently, a stony talus or toe slope is present at the base of the cliff, fig. 2, and, unless recently disturbed, supports a mixed forest. A mantle of surficial material covers the bedrock at the top and forms the brow or upper slope of the bluff. In some places, as in parts of Morgan and Madison counties, sandy loess and colluvium completely mantle and conceal the bedrock.

Surficial Material.—Surficial material, the unconsolidated material above the bedrock, may be residual or transported. Residual material, which supports both prairie and forest in Illinois, occurs south of the glaciated area, as, for instance, on the rocky slopes at Cave Creek prairie and the cherty ridge-top at Tamms. On most other prairie slopes the surficial material is transported—loess or glacial drift.

Loess, a windblown accumulation of silt with subordinate clay and minor amounts of fine sand, occurs over large areas of the Midwest. "One of the most important and best-known occurrences of loess in the world is in the Mississippi River Basin" (Leighton & Willman 1950). Loess mantles most of Illinois except the large stream valleys and areas of lake sediments and sand dunes.

The eolian hypothesis of the origin of loess deposits is the one accepted by most geologists who have studied this material extensively. Udden (1894) wrote, "From a dynamical point of view the wind-theory would appear to furnish an adequate explanation of the occurrence of the loess in the Mississippi valley, at least as to most of its phases." Shimek (1896) advocated the eolian hypothesis and based his conclusions in part upon the land snail shells he found in loess. Chamberlin (1897) presented the hypothesis that loess (of the Mississippi Valley) is a wind deposit and that the sources of the material were the floodplain deposits of the glacial rivers. The hypothesis of the origin of loess deposits from backswamp sediments (Russell 1944) does not seem tenable for Illinois.

The thickest loess deposits in Illinois

are found along the east bluffs of the Mississippi and Illinois rivers, where, in some places, they are more than 300 inches in depth. Such thick deposits occur in places where the valley changes from a northwest-southeast trend to one that is north-south or northeast-southwest, as in

In Illinois, soils derived from loess support both prairie and forest.

The only bluff prairie slopes that are mantled by glacial drift and that the writer examined for this report are in Putnam County. These bluffs were last covered by ice during the Tazewell sub-



Fig. 3.—Calcareous concretions or "loess kindchen" from Phegley hill prairie near Prairie du Rocher, Randolph County. Such concretions are common on many prairie slopes in Illinois.

Carroll, Madison, and Jackson counties. Other deposits of great thickness occur just east of the wide portions of the main valleys, as east of the Illinois River valley from Mason County south into Morgan County. Away from the main river valleys the loess deposits become progressively thinner. Not only do the deposits of loess become thinner but also the mean particle size decreases with distance from the bluffs (Smith 1942). Loess on the bluffs in many places is somewhat sandy.

The hydrogen-ion concentration of loess, as determined with a Beckman pH meter in samples from 10 hill prairies in southern and central Illinois, ranges from 7.86 to 8.41. All samples, when treated with dilute hydrochloric acid, effervesced freely, showing the presence of calcium carbonate. Calcium carbonate is often found in the form of concretions, "loess kindchen," fig. 3, on prairie slopes.

stage of the Wisconsin glaciation, fig. 4. Soils derived from till support both prairie and forest in Illinois.

Exposure.—Hill prairies are most abundant on the northeast sides of the valleys, fig. 1, where the bluffs trend northwest-southeast, or on bluffs that border the wide, flat bottomlands or broad, flat terraces over which winds blow with little hindrance, or on bluffs that are high. Certain physiographic situations, direction and steepness of slopes, altitudes of bluffs, and width of adjacent bottomlands are very advantageous in bringing about high temperature and low humidity, two conditions that favor a high evaporation rate, which in turn favors prairie (Shimek 1911). Southwest- and west-facing bluff slopes receive more nearly at right angles the rays of the hot afternoon (2 o'clock) summer sun than do other slopes. Slopes that face these directions are subject to

higher temperatures. Such slopes, especially those of high bluffs, are also directly exposed to the prevailing southwesterly

winds of the growing season, which increase the water-loss both from plants and the surface soil. The upper bluff slopes are consequently extremely xeric and support prairie rather than forest.

Where the bottomlands are wide, wind movement is unimpeded for some distance. Brow slopes of bluffs bordering such bottomlands are xeric. Accordingly, hill prairies are common in the northern part of the American Bottoms in Madison and St. Clair counties where the Mississippi River valley is wide. In northern Cass County, hill prairies are found on bluffs that trend almost east-west and that border a broad, flat, sandy terrace that extends to the Illinois River, which here flows southwestward. The xeric conditions on these brow slopes result in part from the movement of westerly winds over the broad, flat, sandy terrace and in part from the deep mantle of very sandy loess, which favors rapid loss of water by downward percolation.

STAGE	SUB-STAGE
WISCONSIN GLACIAL	MANKATO
	CARY
	TAZEWELL
	IOWAN
	FARMDALE (PRO-WIS.)
SANGAMON INTERGLACIAL	
ILLINOIAN GLACIAL	BUFFALO HART JACKSONVILLE PAYSON
	LOVELAND (PRO-ILL.)
YARMOUTH INTERGLACIAL	
KANSAN GLACIAL	
	PRO-KANSAN?
AFTONIAN INTERGLACIAL	
NEBRASKAN GLACIAL	

Fig. 4.—Classification of geologic time during the Pleistocene Period. (After Leighton & Willman 1950.)

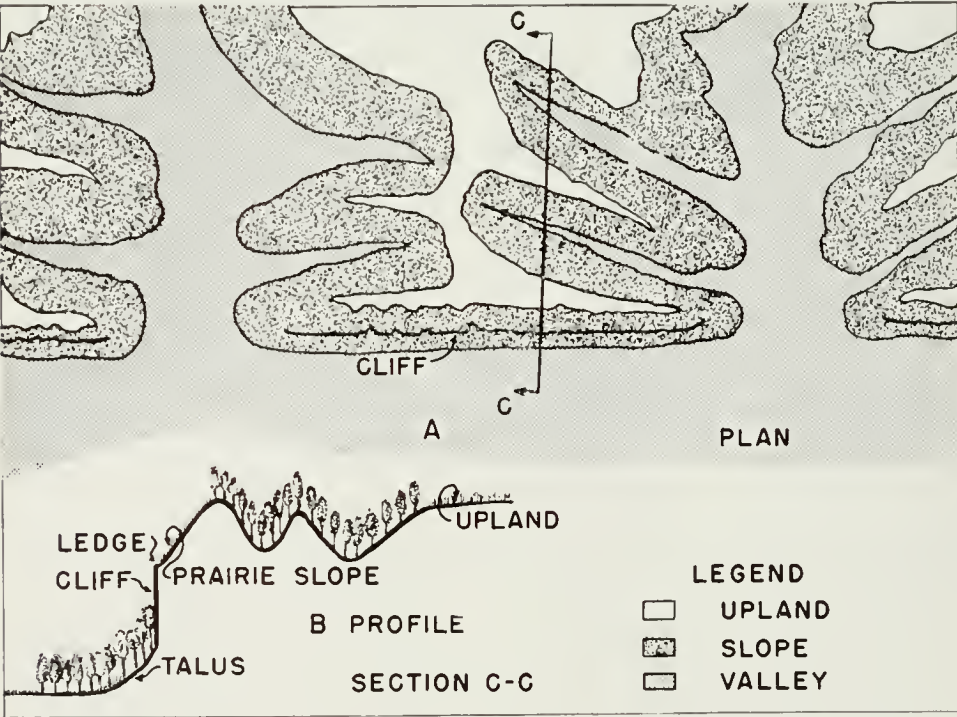


Fig. 5.—Schematic plan, A, and profile, B, of a bluff of type common along major stream valleys in Illinois. The steep valley wall between the two large tributary valleys in the plan is the bluff shown in the profile (section C-C). The bluff includes a talus or toe slope, a cliff, a rock ledge, and an upper or brow slope, which in the profile shows a cover of prairie.

Hill prairies are absent from the generally northeast-facing slopes of the bluffs on the southwest sides of valleys; these slopes are covered by forests except where they have been cleared and are now in cultivation.

Altitude.—A relationship apparently exists between height of the bluffs and occurrence of hill prairies. More prairie openings and prairie strips are found on the Mississippi River bluffs in Pike, Calhoun, Monroe, and Randolph counties where the bluffs are high than on those bluffs just north or south of Quincy in Adams County where the bluffs are low. At Clendenny prairie (Calhoun County), the bluff rises 220 feet above the bottomland; at Sessions (Pike County), 240 feet; at Fults (Monroe County), 340 feet; and at Phegley and Sampson (Randolph County), 310 feet. The bluffs north of Quincy are only slightly more than 100 feet and those south of Quincy are but 120 feet above the Mississippi River bottomland.

Parallel Tributary Valleys.—During the course of field work, the writer observed an interesting feature of the bluffs. In 34 of the 61 hill prairies visited, tributary valleys are found approximately parallel to and short distances back of the bluffs, fig. 5. In each of the 34 sites, the area between the major stream valley and the parallel valley, or valleys, is a narrow ridge that is joined to the upland beyond by another narrow ridge more or less at right angles to the bluff. Hill prairies grow on the upper slope of the ridge that faces the major stream valley, a slope referred to as the upper bluff slope or the brow slope. Narrow ridges of this type occur where streams have cut back into the valley wall and where, at approximately right angles to them, their tributaries have developed. The tributary valleys, mostly parallel to the bluffs, are V-shaped and forest covered.

Environmental Conclusions

As the climate and soils of Illinois permit the growth of both prairie and forest, it can be concluded that certain geomorphic conditions are accountable for the occurrence of hill prairies on the upper bluff

slopes. Location, the place in reference to major stream valleys, and topography, largely the result of the geomorphic history of the region, exert strong influences, or controls, that are responsible for the presence of hill prairies. The growth of grassland rather than forest on the upper bluff slopes is attributed to priority of occupation by prairie species and to the xeric conditions that are produced by the combination of local exposure to the sun and to the wind (especially to wind moving unimpeded across wide floodplains), the height of the bluffs above the adjacent bottomlands, the steepness and direction of the upper slopes, and the permeability of the substratum. Thus, the hill prairie community is the result of a complex set of conditions, the effectiveness of which is determined by location and topography.

VEGETATION OF HILL PRAIRIES

The typical vegetation of hill prairies is the bunch-grass type. In most places, *Andropogon scoparius* is the dominant species. In some places, such bunch grasses as *Bouteloua curtipendula*, *A. gerardi*, and *Sorghastrum nutans* are locally dominant. In order to learn about the vegetation, its density, the ground space it occupies, the foliage area or crown cover, the available space per plant, and the frequency of occurrence of species in plots of several sizes, the writer made detailed studies of hill prairie vegetation by means of plot studies in two prairies. He also made studies of some characteristics of all stands from species lists and field notes.

Phegley and Sampson Prairies

From the 61 hill prairies that he visited, the writer chose Phegley and Sampson hill prairies for the detailed vegetational studies. These areas are on the same bluff ridge. In their surface features, Phegley and Sampson prairies are typical of hill prairies. There is a rock ledge and cliff at their base. A stony slope lies above the rock ledge, and loess caps the bluff. Each prairie area possesses spurs and coves. At the time this study was made, prairie covered both the stony



Fig. 6.—Steep spur front in unpastured Sampson hill prairie, north of Prairie du Rocher, Randolph County, showing some slumping of the loess.



Fig. 7.—Steep spur front in pastured Phegley hill prairie, north of Prairie du Rocher, Randolph County, showing considerable slumping of the loess.

and loess slopes. The Phegley prairie was pastured; the Sampson was not. Thus, it was possible to compare pastured and unpastured prairie slopes in the same locality.

Because Phegley and Sampson prairies were accessible to the writer by automobile, no laborious and time-consuming ascent from the bottomland, up the basal slopes and over the rock ledge, was neces-

sary; steep climbs are necessary to attain the majority of hill prairies in Illinois.

Study Procedures.—For detailed vegetation studies in hill prairie, the upper slopes of spurs seemed to be the best sites because these slopes had a vegetation that was nearly "pure" prairie, and they had surfaces that showed little erosion. The steep spur fronts, figs. 6 and 7, contained species characteristic of prairie but showed

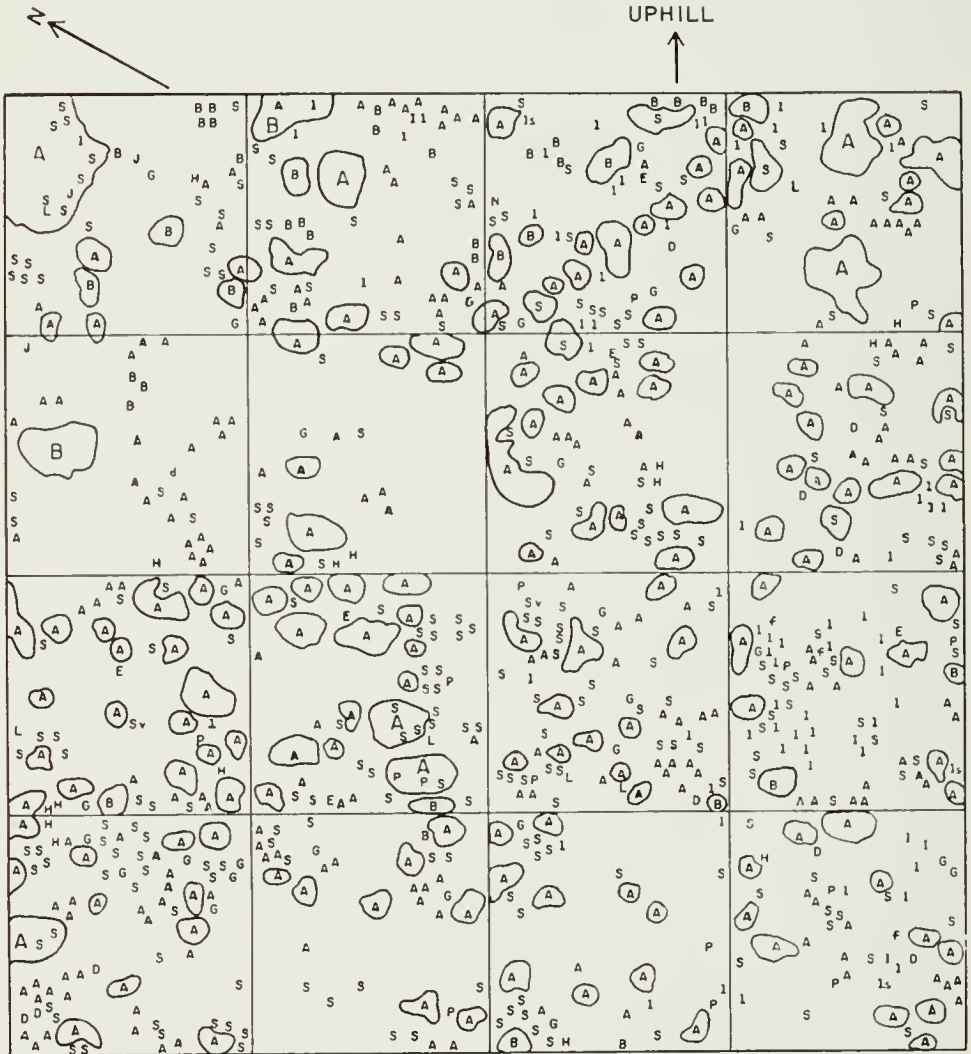


Fig. 8.—A 1-milacre quadrat in the pastured Phegley hill prairie, charted October 9 and 10, 1951, by A. G. Vestal and R. A. Evers. A, *Andropogon scoparius*; S, *Solidago nemoralis*; I, *Lespedeza stipulacea*; B, *Bouteloua curtipendula*; G, *Gerardia* sp.; P, *Petalostemum purpureum*; H, *Houstonia nigricans*; D, *Desmodium ciliare*; L, *Lespedeza capitata*; E, *Euphorbia corollata*; f, *Cassia fasciculata*; J, *Juniperus virginiana*; ls, *Linum sulcatum*; N, *Senecio platensis*; v, *Polygala verticillata*; and d, *Hedeoma hispida*.

more or less slumping of loess and, as a consequence, possessed sizable areas without plant cover. The more gentle slopes near the bases of the prairies had less severely eroded surfaces, and consequently more plant cover, than the steep spur fronts, but they contained more species characteristic of rock ledges.

Sizes and Shapes of Study Plots.—A 9-milacre square was staked on the upper

slope of a spur of each of the prairies, Phegley and Sampson. These plots were located at some distance from the crest of the bluff in an attempt to exclude forest plants and pasture weeds. Each 9-milacre square was then divided into nine 1-milacre quadrats (0.001 acre or 4.046 square meters). The central milacre of the 9-milacre grid was selected for mapping.

Each central milacre was divided into

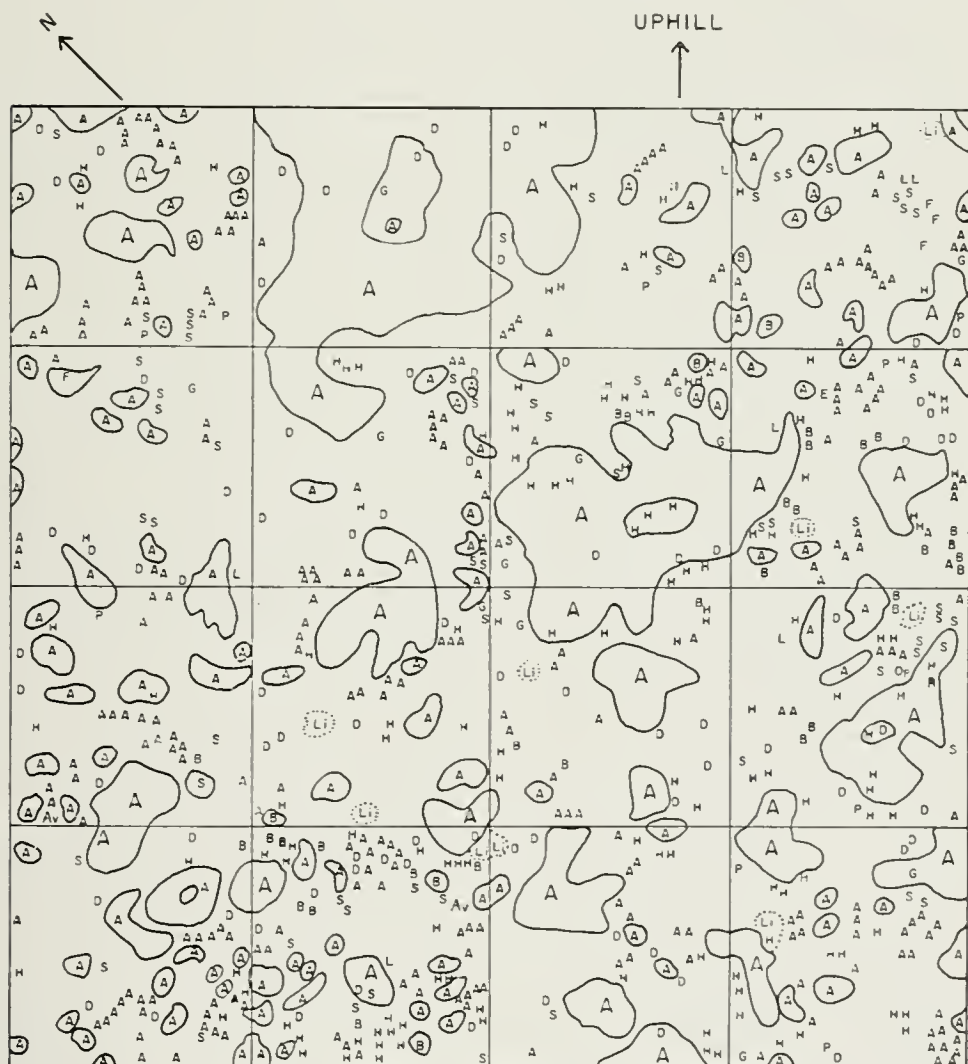


Fig. 9.—A 1-milacre quadrat in the unpastured Sampson hill prairie, charted October 15 and 16, 1951, by R. A. Evers. A, *Andropogon scoparius*; Li, *Lecidea* spp.; H, *Houstonia nigricans*; D, *Desmodium ciliare*; S, *Solidago nemoralis*; B, *Bouteloua curtipendula*; G, *Gerardia* sp.; P, *Petalostemum purpureum*; F, *Andropogon gerardi*; L, *Lespedeza capitata*; Av, *Agave virginica*; E, *Euphorbia corollata*; Op, *Opuntia rafinesquii*.

64 small squares of 1/64 milacre (approximately 6.25 square decimeters) to facilitate mapping. These small units were combined in working over the data to give 1/16-, 1/4-, and 1-milacre plots. The central milacre quadrat in the Phegley prairie was mapped, fig. 8, and the shoots in this milacre were counted on October 9 and 10, 1951, by the writer

each with an area of 5 milacres and five each of 10 milacres. Species lists were then compiled for the staked areas of each prairie by units of 1/64, 1/16, 1/4, 1, 3, 5, 9, 10, 25, 50, and 75 (303.5 square meters) milacres.

From data obtained from the staked areas, it was possible to determine the number of plant species and number of

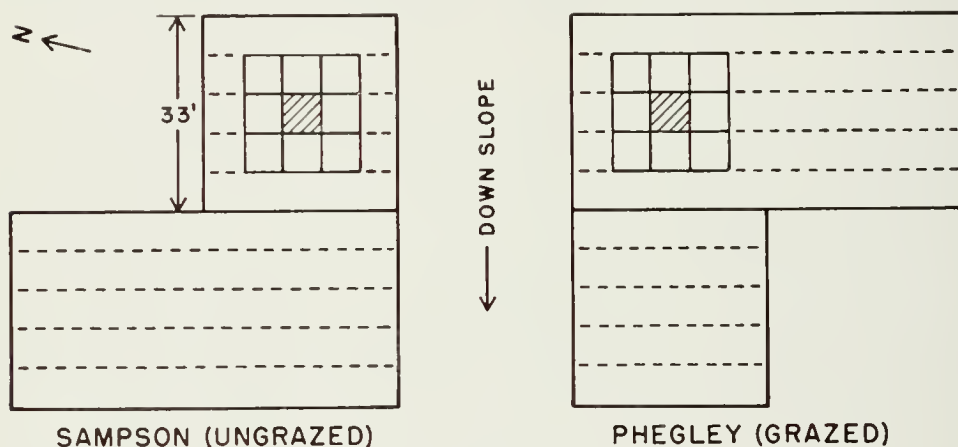


Fig. 10.—Arrangement of plots and strips in two hill prairies. Each shaded square represents the mapped central milacre of a 9-milacre grid.

with the assistance of Dr. A. G. Vestal; the central milacre in Sampson prairie was mapped, fig. 9, and the shoots were counted on October 15 and 16, 1951, by the writer. In addition, a list of plant species was made for each 1/4 milacre in the other 8 milacres of each of the 9-milacre grids.

In order to find the increase in number of species with an increase in area, the writer staked a 25-milacre square and a 50-milacre rectangle in each of the two prairies, fig. 10. In Phegley, the 25-milacre square was downslope from the north half of the 50-milacre plot, the half that included the 9-milacre square. In Sampson, because of the proximity of woodland, the arrangement could not be made identical with the arrangement of plots in Phegley; the 9-milacre square was inside the 25-milacre square; the south half of the 50-milacre rectangle was downslope from the 25-milacre square. The staked 25- and 50-milacre plots were divided into strips 6.6 feet wide, making five strips

shoots in plots of various sizes; for each species, the frequency of occurrence in plots; for each of the several grass species, the area covered or ground space of plants; and, for all species collectively, the estimated number of plants per unit of area and the available space per plant. Comparisons between pastured and un-pastured hill prairie were made. From the data it was possible to construct a species-area curve and from the curve to find the sizes of certain reference areas, as will be explained later in this section.

Method of Counting Plant Units.—

For plants other than grasses, each shoot that appeared above the ground surface and was without obvious connection to another shoot was counted as one unit, or individual. For example, each single rosette of *Solidago nemoralis* was counted as one individual; each shoot of *Houstonia nigricans*, *Petalostemum purpureum*, and *Desmodium ciliare* was counted as one individual unless connections with other shoots could be traced.

For the three bunch grasses, *Andropogon scoparius*, *A. gerardi*, and *Bouteloua curtipendula*, the shoots that grew as individuals or in small bunches were counted and recorded. In the Phegley prairie, the shoots were small and mostly distinct and separate. In the Sampson prairie, the shoots were mostly aggregated into "tufts," and these into bunches of varying sizes. In this prairie, *A. scoparius* occurred also in several large patches within the plots. The number of shoots in such patches was estimated as follows: the average number of shoots per square inch in the smaller bunches was determined by counts; this number was multiplied by the number of square inches in each of the larger patches.

During later stages of preparation of this report, it was evident that an estimate of numbers of grass-plant individuals per unit of area could be of great value in finding average plant densities in hill prairies. Other workers have made such estimates. Steiger (1930), in his study of high and low prairies of Nebraska, apparently counted each occurrence, whether a single shoot or a bunch, as a grass-plant individual. From the quadrat maps in his report, the bunches of grass appear not so large as those in hill prairies in Illinois. Korstian & Coile (1938), in a study of plant competition in forest stands, found the most densely covered forest-floor milacre had about 10 grass plants per 0.01 milacre. "Thus each 0.01 milacre occupied by a colony was regarded as fully stocked, even though it contained few or no individual plants." Neither Steiger's procedure nor the one followed by Korstian & Coile seemed adequate for Illinois hill prairies. The estimate of numbers of grass-plant individuals for these prairies was therefore made by a different method.

Two bunches of *Andropogon scoparius* were obtained, one from the Northeast Meredosia prairie, one from the basal slope at Reavis Spring prairie. Each bunch was taken from an ungrazed prairie strip that was separated from the adjacent grazed prairie slopes by a fence. These bunches were carefully dissected to find how many shoots were connected by living stems in what might be considered as individual plants. For convenience,

each aggregate of shoots considered to be an individual plant was called a tuft. Before separation, each bunch was mapped with a pantograph to show foliage area or crown cover, area at ground surface, location of solitary live shoots, and what appeared to be aggregates of shoots or "apparent tufts." (It was recognized that separation of a bunch into tufts might give very different results from those of the preliminary surface examination.) It was found that the average number of shoots per tuft of *A. scoparius* was 3.375 for the Northeast Meredosia sample and 3.793 for the one from Reavis Spring. The characteristic tuft (grass-plant individual) of *A. scoparius* was found to be an aggregate of 3 or 4 shoots, average 3.5.

The same method was used by H. A. Moore and A. G. Vestal to determine the number of shoots per plant individual for *Andropogon gerardi*. In a clump of big bluestem, collected by Moore from a railroad trackway east of Urbana, Moore and Vestal found by separation that the average number of shoots per tuft or grass plant was 1.739. The characteristic tuft (grass-plant individual) of big bluestem consisted of 1 or 2 shoots, average 1.75.

As a preliminary step in estimating the number of plants of *Bouteloua curtipendula*, the writer obtained a small sample from Mud Creek prairie and carefully dissected the bunches to determine the number of shoots per plant or tuft. It was found that the average number of shoots per tuft was 3.437; the individual plant of *B. curtipendula* was an aggregation of 3 or 4 shoots, average 3.5.

For each of the bunch-grass species, the estimated number of tufts in bunches was found by dividing the number of shoots in bunches by the average number of shoots per tuft, or by a factor based upon this average.

Density of Vegetation.—The measure of vegetation density in this study is the number of plants per milacre. The mapped central milacre of the Sampson and that of the Phegley prairie were used in determining density for this report.

Grasses.—In the central milacre of the Sampson prairie, 4,051 shoots of *Andropogon scoparius* grew in bunches and patches. The 4,051 shoots formed an es-

timated 1,157 grass-plant individuals or tufts. This estimate was reached by dividing the number of shoots in bunches and patches (4,051) by the number of shoots in a typical tuft (3 or 4, average 3.5). There were in addition 247 shoots not aggregated into tufts or bunches. These were considered individual plants, as it was impossible to determine any underground connections without digging and removing these shoots from the milacre. The estimated total number of individuals of *A. scoparius* was 1,404.

In the Phegley prairie, the shoots of *Andropogon scoparius* were mostly short and well separated, with very little lateral extension of the foliage. The open appearance of each bunch, the large proportion of bare ground, and the considerable ground area per shoot within the bunches were attributed to grazing and trampling by cows. Cows doubtless destroyed many shoots either by pulling them out or breaking them off and thus materially reduced the number of shoots per tuft.

In the samples taken from ungrazed hill prairie in two sites, Northeast Meredosia and Reavis Spring, the number of shoots per tuft averaged between 3 and 4. In the mapped central milacre of the pastured Phegley prairie, the number of shoots per tuft was not so large; it was conservative to place the number of shoots per tuft at one-half that of ungrazed prairie, that is, 1.5 or 2.0, average 1.75. The 1,143 shoots in bunches thus formed an

estimated 653 tufts or grass-plant individuals. In addition, 196 isolated shoots, representing that many isolated plant individuals, were counted. The estimated total number of *A. scoparius* plants was 849.

In the mapped Sampson milacre, 22 shoots of *Andropogon gerardi* were found; 19 of these occurred in one bunch. These 19 shoots formed 11 plant individuals (estimated). With the 3 isolated plants added, the estimated number of *A. gerardi* individuals was 14. *A. gerardi* did not occur in the mapped milacre in the Phegley prairie.

In the central milacre of Sampson, 6 bunches of *Bouteloua curtipendula* with 43 shoots were mapped. These 6 bunches contained an estimated 12 plants. In addition, 32 isolated plants were counted. The estimated number of individuals of *B. curtipendula* was 44.

In the mapped Phegley milacre, 15 bunches of *Bouteloua curtipendula* with 108 shoots were charted. These 15 bunches contained an estimated 31 plants. In addition, 25 isolated plants were counted. The estimated number of individuals of *B. curtipendula* was 56.

The ungrazed Sampson prairie contained an estimated 1,462 grass plants in the central milacre; the grazed Phegley prairie 905 in the central milacre. Table 1 summarizes the above data.

Plants Other Than Grasses.—Of plants other than grasses in the central milacre of Sampson prairie, 487 plants of

Table 1.—Shoot counts and estimated numbers of bunch-grass plant individuals in the mapped central milacre of Sampson and of Phegley hill prairies.

KIND OF GROWTH	SAMPSON PRAIRIE				PHEGLEY PRAIRIE		
	<i>Andropogon scoparius</i>	<i>Andropogon gerardi</i>	<i>Bouteloua curtipendula</i>	Total	<i>Andropogon scoparius</i>	<i>Bouteloua curtipendula</i>	Total
Shoots aggregated in bunches...	4,051	19	43	4,113	1,143	108	1,251
Isolated shoots...	247	3	32	282	196	25	221
Total...	4,298	22	75	4,395	1,339	133	1,472
Plants in bunches (estimated)...	1,157	11	12	1,180	653	31	684
Isolated plants (estimated)...	247	3	32	282	196	25	221
Total...	1,404	14	44	1,462	849	56	905

Table 2.—Species and numbers of plant individuals in the central milacre of Sampson hill prairie.

SPECIES	NUMBER OF PLANT INDIVIDUALS
<i>Andropogon scoparius</i>	1,404*
<i>Houstonia nigricans</i>	141
<i>Desmodium ciliare</i>	80
<i>Solidago nemoralis</i>	64
<i>Bouteloua curtipendula</i>	44*
<i>Andropogon gerardi</i>	14*
<i>Gerardia</i> sp.†.....	11
<i>Petalostemum purpureum</i>	9
<i>Lespedeza capitata</i>	6
<i>Agave virginica</i>	2
<i>Euphorbia corollata</i>	1
<i>Opuntia rafinesquii</i>	1
<i>Lecidea</i> spp.....	172*

* Estimated.
† Possibly *G. gattingeri*.

10 different species were mapped and counted; in the central milacre of Phegley prairie, 436 plants of 14 species. Table 2 shows density for both grass and non-grass species in the mapped Sampson milacre; table 3 gives similar information for species in the mapped Phegley milacre.

Total Densities.—In Sampson prairie, the density in the mapped central milacre was 1,949 plants; in Phegley, 1,341.

In both prairies, grass-plant individuals were more numerous than the nongrass plants. In Sampson, 75 per cent of the plant individuals were grasses and 25 per cent were not grasses; in Phegley, 67 per cent were grasses and 33 per cent were not. It is of interest that the nongrass species made up a higher percentage of the individual plants in grazed prairie than in ungrazed.

Ground Space of Plants.—Ground space of plants is considered here as the area occupied by the plants at ground sur-

Table 3.—Species and numbers of plant individuals in the central milacre of Phegley hill prairie.

SPECIES	NUMBER OF PLANT INDIVIDUALS
<i>Andropogon scoparius</i>	849*
<i>Solidago nemoralis</i>	270
<i>Lespedeza stipulacea</i>	71
<i>Bouteloua curtipendula</i>	56*
<i>Gerardia</i> sp.†.....	29
<i>Petalostemum purpureum</i>	15
<i>Houstonia nigricans</i>	13
<i>Desmodium ciliare</i>	11
<i>Lespedeza capitata</i>	8
<i>Euphorbia corollata</i>	6
<i>Cassia fasciculata</i>	4
<i>Juniperus virginiana</i> ‡.....	3
<i>Linum sulcatum</i>	3
<i>Senecio plattensis</i>	1
<i>Polygala verticillata</i>	1
<i>Hedeoma hispida</i>	1

* Estimated.
† Possibly *G. gattingeri*.
‡ Small seedlings.

face. The writer determined the ground space for grasses, table 4, from the maps of the central milacre of Phegley and Sampson prairies by use of a planimeter.

Phegley Prairie.—In the central milacre of this pastured prairie, *Andropogon scoparius* covered at ground level 1,107 square inches (71 square decimeters*), or 17.64 per cent of the milacre; *Bouteloua curtipendula* occupied 138.4 square inches (9 square decimeters), or 2.21 per cent of the milacre, tables 4 and 6. The two bunch grasses covered 1,245.4 square inches (80 square decimeters), or 19.85 per cent of the quadrat at ground level.

Most of the plants other than grasses, 437 individuals of 14 species, occurred in the spaces between the grass bunches. The

*Metric equivalents in this section on ground space are given to the nearest whole number.

Table 4.—Ground space or areas (square inches) occupied at ground surface by the bunch grasses in the central milacre of Sampson and of Phegley hill prairies.

TYPE OF PLANT GROWTH	SAMPSON PRAIRIE				PHEGLEY PRAIRIE		
	<i>Andropogon scoparius</i>	<i>Andropogon gerardi</i>	<i>Bouteloua curtipendula</i>	Total	<i>Andropogon scoparius</i>	<i>Bouteloua curtipendula</i>	Total
Bunches.....	1,678 0	8 7	18 8	1,705 5	945 0	112 4	1,057 4
Isolated shoots.....	103 0	1 3	10 5	114 8	162 0	26 0	188 0
Total.....	1,781 0	10 0	29 3	1,820 3	1,107 0	138 4	1,245 4

estimated ground space covered by these plants was 157.9 square inches, table 5, an estimation computed in the following manner. There were 29 rosettes of *Solidago nemoralis* that were clustered into five groups or patches. The five patches occupied 36.59 square inches in the central milacre. The remaining 241 rosettes of this species were small and covered about 0.5 square inch each, or a total of 120.5 square inches. The total ground space of *S. nemoralis* for the milacre was 157.09 square inches. The remaining 167 individuals of 13 species were small and averaged only 0.08 inch (2 mm.) in diameter, or 0.0049 square inch in area. The estimated ground space of these plants was 0.82 square inch (167 x 0.0049). The estimated ground space for all the nongrass species was 157.9 square inches (10 square decimeters), or 2.52 per cent of the quadrat, tables 5 and 6. The total ground space for all plants in the central milacre at Phegley prairie was 1,403.3 square inches (91 square decimeters), or 22.37 per cent of the quadrat. There remained 4,869.3 square inches, or 77.63 per cent of the quadrat, that was bare loess, tables 5 and 6.

Sampson Prairie.—In the central milacre of this unpastured prairie, *Andropogon scoparius* covered 1,781 square inches (115 square decimeters), or 28.39 per cent of the milacre; *Bouteloua curtipendula* and *A. gerardi* together occupied 39.3 square inches (3 square decimeters), or 0.63 per cent of the plot, tables 4 and 6. The three bunch grasses covered at ground level 1,820.3 square inches (117 square decimeters), or 29.02 per cent of the milacre.

The ground space for the remaining 487 plant individuals of 10 species was computed in the same manner as was the ground space for the plants in Phegley. *Lecidea*, which grows over the surface of the loess, occupied 29.6 square inches of the milacre as computed from the map by use of a planimeter. The *Agave* and *Opuntia* were each about 0.625 inch in diameter at the ground surface; the three plants occupied approximately a square inch. The 64 small rosettes of *Solidago nemoralis* covered 32.0 square inches (64 x 0.5). The remaining 248 plants,

Table 5.—Ground space or areas (square inches) occupied at ground surface by grass plants, plants other than grasses, and bare loess in the central milacre of Sampson and of Phegley prairies.

TYPE OF PLANT GROWTH	SAMPSON PRAIRIE	PHLEGLEY PRAIRIE
Bunch grasses.....	1,820.3	1,245.4
Plants other than grasses...	63.8	157.9
All plants.....	1,884.1	1,403.3
Bare loess.....	4,388.5	4,869.3

Table 6.—Per cent of the central milacre of Sampson and of Phegley hill prairies occupied at ground surface by bunch grasses, plants other than grasses, and bare loess.

SPECIES OR TYPE OF PLANT GROWTH	SAMPSON PRAIRIE	PHLEGLEY PRAIRIE
<i>Andropogon scoparius</i>	28.39	17.64
<i>Andropogon gerardi</i>	0.16	0.00
<i>Bouteloua curtipendula</i>	0.47	2.21
All bunch grasses.....	29.02	19.85
Plants other than grasses...	1.02	2.52
All plants.....	30.04	22.37
Bare loess.....	69.96	77.63

all small, covered 1.2 square inches. The nongrass species together occupied 63.8 square inches (4 square decimeters), or 1.02 per cent of the quadrat, tables 5 and 6. The total ground space for the plants in this milacre of ungrazed prairie was 1,884.1 square inches (122 square decimeters), or 30.04 per cent of the charted area. There remained 4,388.5 square inches or 69.96 per cent of the quadrat not occupied at ground level by plants.

Foliage Area or Crown Cover.—Foliage area, crown area, or crown cover is considered here as the area that would be mapped if the crowns of the plants were projected on the ground surface directly below. Although foliage area was not mapped in the field, it was estimated in the following manner.

In the Sampson prairie, *Andropogon scoparius* had a large foliage area, fig. 11. The aspect of this grass in Sampson was similar to its aspect at Northeast Meredosia, where a sample was collected for separation. Foliage area of this sample was mapped. A factor of approximately 2.7 was derived when foliage area of the sample was divided by its ground space.



Fig. 11.—Upper spur slope in ungrazed Sampson hill prairie. The foliage area of the plants is much greater here than in the grazed Phegley prairie. *Andropogon scoparius* is the dominant grass; *A. gerardi* also is present. The above view is to the left (northwest) of plots staked for vegetation studies of this report.



Fig. 12.—Upper spur slope in the grazed Phegley hill prairie. The foliage area of the plants is small. *Andropogon scoparius* is the dominant grass. To the right in the above view is a small part of some of the plots staked for the vegetation studies of this report.

Table 7.—Foliage area (square inches) for plants in the central milacre of Sampson and of Phegley hill prairies.

SPECIES OR TYPE OF PLANT GROWTH	SAMPSON PRAIRIE	PHEGLEY PRAIRIE
<i>Andropogon scoparius</i>	4,809	1,994
<i>Andropogon gerardi</i>	27	0
<i>Bouteloua curtipendula</i>	60	285
All bunch grasses.....	4,896	2,279
Plants other than grasses...	92	246
All plants.....	4,988	2,525

In order to estimate foliage area of *A. scoparius* in the central milacre of Sampson, the writer multiplied the ground-space value of this grass by 2.7. The same factor was used in order to estimate foliage area for *A. gerardi*. For *Bouteloua curtipendula*, a factor of 2.06 was used; this figure was indicated by separation of the sample from Mud Creek prairie. The estimated foliage area for all grass species in the central milacre of Sampson was 4,896 square inches, table 7. For *Solidago* rosettes, growing on the surface of the soil, foliage area was assumed to be the same as ground space. The lichens, *Lecidea*, are not included here as their thalli—simple plant bodies without true roots, stems, or leaves—grow under the foliage cover of other plants and thus do not contribute to foliage area. The estimated foliage area of *Agave* and *Opuntia* was 10.35 square inches. For the remaining 251 plants, mostly seedlings or small plants, the foliage area was estimated at 0.2 square inch per plant. The aggregate foliage area of plants other than grasses was estimated to be 92 square inches. The total estimated foliage area in the central milacre of the Sampson prairie was 4,988 square inches or 79.52 per cent of the milacre, tables 7 and 8.

In the Phegley prairie, both in the central milacre and in the prairie as a whole, *Andropogon scoparius* showed obvious reduction of cover, fig. 12, both at ground level and at foliage levels as compared with this species in the unpastured prairie. The leaves covered an area larger than the ground space, but not so large as the area covered by the leaves in the Sampson prairie. Foliage area for *A. sco-*

Table 8.—Foliage area (per cent of total area) for plants in the central milacre of Sampson and of Phegley hill prairies.

SPECIES OR TYPE OF PLANT GROWTH	SAMPSON PRAIRIE	PHEGLEY PRAIRIE
<i>Andropogon scoparius</i>	76.66	31.79
<i>Andropogon gerardi</i>	0.43	0.00
<i>Bouteloua curtipendula</i>	0.96	4.54
All bunch grasses.....	78.05	36.33
Plants other than grasses...	1.47	3.92
All plants.....	79.52	40.25

parius in the central milacre of the Phegley prairie was estimated at 1.8 times the ground space; this factor multiplied by the ground space gave an aggregate foliage area of 1,994 square inches, table 7. For *Bouteloua curtipendula*, the factor 2.06 was again used (as in Sampson), which gave for this species in Phegley an estimated foliage area of 285 square inches. Plants of *Lespedeza stipulacea*, with an estimated foliage area of 1.5 square inches per plant, had an estimated aggregate area of 106 square inches. For prostrate rosettes of *Solidago*, the foliage area was considered to be equivalent to ground space (as in Sampson). For the remaining plants, all small and mostly seedlings, foliage area was estimated at 0.2 square inch per plant. Plants other than grasses had an estimated aggregate foliage area of 246 square inches. The total estimated foliage area in the central milacre of the Phegley prairie was 2,525 square inches, or 40.25 per cent of the milacre, tables 7 and 8.

Available Space per Plant.—Available space per plant, the inverse of plant density, is another character that, like density, can be useful in descriptions and comparisons of vegetation. It is simply obtained by dividing the area of the measured sample by the number of plants in it.

Variables affecting available space per plant are size of plants, degree of crowding, and percentage of the measured area covered by plants. In those vegetations which show great disparity in sizes of plants of different species, as sagebrush with short-grass, average available space per plant should be separately found for each component or layer. In the Illinois hill prairies studied, individuals of the

Table 9.—Available space per plant in the central milacre of Sampson and of Phegley hill prairies.

HILL PRAIRIE	AREA OF MILACRE IN SQUARE INCHES	NUMBER OF PLANTS	AVAILABLE SPACE PER PLANT	
			Square Inches	Square Centimeters
Sampson.....	6,272.64	1,949	3.22	20.77
Phegley.....	6,272.64	1,341	4.68	30.19

three bunch-grass species are not so different in size from the plants of most other herb species (most of them dicotyledons) as to call for separate estimations of available space for grasses and for other herbs.

Available space per plant for Sampson and Phegley hill prairies is given in table 9.

Numbers of Plant Species for Various Plot Sizes.—From the species lists compiled for plot sizes ranging from 1/64 milacre to 75 milacres, it was possible to find the average number of plant species in plots of several sizes and also the increase in number of species with an increase in area.

Sampson Prairie.—In the central milacre of the Sampson prairie, for plots of 1/64-milacre size the average number of species was 3.79, the average number of individuals, 30.45. One of the plots of this size contained but one species, *Andropogon scoparius*; the plot with the greatest number of species contained seven, *Andropogon scoparius*, *Solidago nemoralis*, *Houstonia nigricans*, *Desmodium ciliare*, *Bouteloua curtipendula*, *Agave virginica*, and *Lecidea* sp.

Plots of 1/16-milacre size in the central milacre contained 3 to 10 species each and averaged 6.56 per plot; the number of plants averaged 121.81. Quadrats of 1/4-milacre size in this milacre contained 7 to 11 species each and averaged 9.5 per plot; the average number of plants was 487.25.

In the 9-milacre square, the species list compiled by 1/4-milacre units showed a range of 5 to 11 species and an average of 7.33 per unit; plots of the 1-milacre size had 9 to 13 species each and averaged 11.22. In the 9-milacre square, a total of 18 species was found. Species not found in the central milacre but found in one

or more of the 8 milacres surrounding it were *Senecio plattensis*, *Carya* sp. (seedling), *Aster patens*, *Sisyrinchium albidum*, and an unidentified moss.

The 9-milacre plot formed a part of the staked 25-milacre square. Species lists were made for the 25-milacre quadrat by 5-milacre strips. Three species, *Juniperus virginiana*, *Kuhnia eupatorioides*, and *Helianthus divaricatus*, not found in the 9-milacre plot, were found in other parts of the 25-milacre quadrat, and brought the total to 21 species for the 25-milacre quadrat.

The 50-milacre rectangle, fig. 10, downslope from the 25-milacre quadrat, was checked by 10-milacre strips. Twenty species were found in this 50-milacre area. Three species, *Aster oblongifolius*, *Elymus canadensis*, and *Eupatorium altissimum*, found here were not found in the 25-milacre unit. However, the species of *Carya*, *Opuntia*, *Sisyrinchium*, and *Helianthus* found within the 25-milacre square were absent from the larger area. In the 75-milacre area, 24 species were present.

Phegley Prairie.—In the central milacre of the Phegley prairie, for plots of 1/64-milacre size the average number of species was 3.94, the average number of plants, 20.95. In one of the plots of this size only one species, *Andropogon scoparius*, with two individuals, was found; the plot with the greatest number of species contained eight, *A. scoparius*, *Solidago nemoralis*, *Houstonia nigricans*, *Gerardia* sp. (possibly *G. gattingeri*), *Lespedeza stipulacea*, *Bouteloua curtipendula*, *Euphorbia corollata*, and *L. capitata*.

Plots of 1/16-milacre size in the central milacre contained 4 to 11 species each and averaged 7.13 per plot. The number of plants in plots of this size averaged 83.81. Quadrats of 1/4-milacre size in this milacre contained 11 or 12 species

each and averaged 11.5. The average number of plants was 335.25 in this size unit.

In the 9-milacre square, the species list compiled by 1 4-milacre units showed a range of 6 to 12 species and an average of 9.27 per unit. The 1-milacre plot size had a range of 11 to 16 species each and an average of 13.44. Ten species not found in the central milacre but found in the surrounding eight were *Andropogon gerardi*, *Lecidea* sp., *Aster patens*, *Eragrostis spectabilis*, *Rhus copallina*, *Kuhnia eupatorioides*, *Panicum scribnerianum*, *Poa pratensis*, *Ruellia humilis*, and a second species of *Gerardia* (possibly *G. aspera*). Twenty-six were found in the 9-milacre quadrat.

The 9-milacre plot formed a part of the staked 50-milacre rectangle, fig. 10, which was examined by 10-milacre strips. Six species not found in the 9-milacre square were found in other parts of the

rectangle. These were *Aster oblongifolius*, *Opuntia rafinesquii*, *Tridens flavus*, *Melilotus alba*, *Rhus aromatica*, and *Eriogeron strigosus*. The first four of these were found only in the 10-milacre strip nearest the improved pasture eastward from the crest of the ridge. This strip, because of its proximity to the pasture, probably should not be considered typical hill prairie. Two species not found in the 9-milacre plot were found in other parts of the four downslope 10-milacre strips and brought the total to 28 species.

The 25-milacre quadrat downslope from the 50-milacre rectangle yielded but one species that did not occur in the 50-milacre rectangle; this was *Asclepias viridiflora*. There were, however, seven species in the four downslope 10-milacre strips of the 50-milacre area that did not occur in the 25-milacre unit. These were *Rhus copallina*, *Kuhnia eupatorioides*, *Panicum scribnerianum*, *Poa pratensis*,

Table 10.—Frequency of occurrence of plant species in plots of five sizes, Sampson hill prairie.

SPECIES	SIZE A 1 256 MILACRE, 0 0156 SQUARE METER)		SIZE B 1 64 MILACRE, 0 0625 SQUARE METER)		SIZE C (1 16 MILACRE, 0 25 SQUARE METER)		SIZE D (1 4 MILACRE, 1 01 SQUARE METERS)		SIZE E (1 MILACRE, 4 05 SQUARE METERS)	
	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots
<i>Andropogon scoparius</i>	60	93 8	64	100 0	16	100 0	36	100 0	9	100 0
<i>Houstonia nigricans</i>	22	34 4	49	78 1	15	93 8	36	100 0	9	100 0
<i>Desmodium ciliare</i>	19	29 7	42	65 6	16	100 0	33	91 7	9	100 0
<i>Solidago nemoralis</i>	13	20 3	32	50 0	15	93 8	33	91 7	9	100 0
<i>Lespedeza capitata</i>	1	1 6	5	7 8	5	31 3	24	66 7	9	100 0
<i>Gerardia gattingeri</i> (?).....	1	1 6	11	17 2	8	50 0	20	55 6	9	100 0
<i>Bouteloua curtipendula</i>	12	18 5	17	26 6	9	56 3	18	50 0	8	88 9
<i>Lecidea</i> spp.....	4	6 3	8	12 5	8	50 0	15	41 7	7	77 8
<i>Andropogon gerardi</i>	—	—	3	4 7	2	12 5	14	38 9	6	66 7
<i>Petalostemum purpureum</i> ...	1	1 6	8	12 5	7	43 8	13	36 1	7	77 8
<i>Senecio plattensis</i>	—	—	—	—	—	—	7	19 4	4	44 4
<i>Euphorbia corollata</i>	—	—	1	1 6	1	6 3	7	19 4	5	55 6
<i>Agave virginica</i>	2	3 1	2	3 1	2	12 5	2	5 6	2	22 2
<i>Opuntia rafinesquii</i>	—	—	1	1 6	1	6 3	2	5 6	2	22 2
<i>Aster patens</i>	—	—	—	—	—	—	1	2 8	1	11 1
<i>Carya</i> sp.....	—	—	—	—	—	—	1	2 8	1	11 1
<i>Sisyrinchium albidum</i>	—	—	—	—	—	—	1	2 8	1	11 1
Unidentified moss.....	—	—	—	—	—	—	1	2 8	1	11 1
	10 species 64 plots		13 species 64 plots		13 species 16 plots		18 species 36 plots		18 species 9 plots	

Hedeoma hispida, *R. aromatica*, and *Gerardia* (possibly *G. aspera*). The 75-milacre unit minus the 10-milacre border strip contained 29 species. The 75-milacre unit contained 33 species.

Frequency of Occurrence of Species.—The frequency, or repeated occurrence, of plant species in Phegley and Sampson prairies was determined from species lists of each of the following plot sizes: 1 256-, 1 64-, 1 16-, 1 4-, and 1-milacre. Although the 1 256-milacre unit was not marked in the field, data for plots of this size were obtained from maps of the mapped central milacre of both Sampson and Phegley prairies, figs. 8 and 9. On such maps the northwest quarter

of the milacre was divided into 64 equal quadrats and, from these, species lists were compiled. The metric equivalent of this quadrat size is 0.0156 square meter. For any given plot size the frequency was expressed as a percentage computed by dividing the number of quadrats in which the species occurred by the total number of quadrats of that size employed.

Sampson Prairie.—Table 10 summarizes the data for the frequency study in ungrazed Sampson prairie. It is evident that the 1 256-milacre size was too small for use in ecological studies of Illinois hill prairies; only one species, *Andropogon scoparius*, attained a high percentage of occurrence. The 1 64-milacre

Table 11.—Frequency of occurrence of plant species in plots of five sizes, Phegley hill prairie.

SPECIES	SIZE A (1 256 MILACRE, 0.0156 SQUARE METER)		SIZE B (1 64 MILACRE, 0.0625 SQUARE METER)		SIZE C (1 16 MILACRE, 0.25 SQUARE METER)		SIZE D (1 4 MILACRE, 1.01 SQUARE METERS)		SIZE E (1 MILACRE, 4.05 SQUARE METERS)	
	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots	Num- ber of Plots	Per Cent of Plots
<i>Andropogon scoparius</i> ...	57	89.1	64	100.0	16	100.0	36	100.0	9	100.0
<i>Solidago nemoralis</i>	42	65.6	59	92.2	16	100.0	36	100.0	9	100.0
<i>Desmodium ciliare</i>	2	3.1	8	12.5	6	37.5	33	91.6	9	100.0
<i>Bouteloua curtipendula</i>	3	4.7	21	32.8	9	56.3	33	91.6	9	100.0
<i>Lespedeza stipulacea</i>	3	4.7	29	45.3	12	75.0	31	86.1	9	100.0
<i>Gerardia gattingeri</i> (?).....	9	14.1	21	32.8	13	81.3	30	88.3	9	100.0
<i>Petalostemum purpureum</i> ...	3	4.7	13	20.3	10	62.5	29	80.6	9	100.0
<i>Houstonia nigricans</i>	3	4.7	11	17.2	10	62.5	27	75.0	9	100.0
<i>Lespedeza capitata</i>	1	1.6	7	10.9	6	37.5	18	50.0	7	77.8
<i>Euphorbia corollata</i>	3	4.7	6	9.4	5	31.3	11	30.6	5	55.6
<i>Juniperus virginiana</i>	—	—	3	4.7	2	12.5	10	27.8	6	66.7
<i>Senecio plattensis</i>	—	—	1	1.6	1	6.3	9	25.0	7	77.8
<i>Cassia fasciculata</i>	—	—	3	4.7	2	12.5	7	19.4	4	44.4
<i>Polygala verticillata</i>	1	1.6	2	3.1	2	12.5	4	11.1	3	33.3
<i>Panicum scribnerianum</i>	—	—	—	—	—	—	4	11.1	3	33.3
<i>Linum sulcatum</i>	—	—	3	4.7	3	19.4	3	8.5	2	22.2
<i>Aster patens</i>	—	—	—	—	—	—	3	8.5	2	22.2
<i>Eragrostis spectabilis</i>	—	—	—	—	—	—	2	5.6	2	22.2
<i>Andropogon gerardi</i>	—	—	—	—	—	—	1	2.8	1	11.1
<i>Lecidea</i> spp.....	—	—	—	—	—	—	1	2.8	1	11.1
<i>Rhus copallina</i>	—	—	—	—	—	—	1	2.8	1	11.1
<i>Kuhnia eupatorioides</i>	—	—	—	—	—	—	1	2.8	1	11.1
<i>Gerardia aspera</i> (?).....	—	—	—	—	—	—	1	2.8	1	11.1
<i>Poa pratensis</i>	—	—	—	—	—	—	1	2.8	1	11.1
<i>Hedeoma hispida</i>	—	—	—	—	—	—	1	2.8	1	11.1
<i>Ruellia humilis</i>	—	—	—	—	—	—	1	2.8	1	11.1
	11 species 64 plots		15 species 64 plots		15 species 16 plots		26 species 36 plots		26 species 9 plots	

size in Sampson was more nearly adequate than the 1 256-milacre size in this ungrazed prairie; 4 species of the 13 found in the 64 plots of the 1 64-milacre size attained a percentage of 50 or more. These 4 species represented 30.77 per cent of the number of species found in the 64 plots. *A. scoparius* occurred in all the quadrats of the 1 64-milacre size. It is evident that the 1 16- and the 1/4-milacre plots (C and D in table 10) gave good

Frequency Values for Combinations of Species.—In Sampson and Phegley prairies, certain species of plants occurred together in so many plots as to call attention to the combinations. In Sampson, the species in combination were *Andropogon scoparius*, *Solidago nemoralis*, *Houstonia nigricans*, and *Desmodium ciliare*. In Phegley, they were *Andropogon scoparius*, *Solidago nemoralis*, *Desmodium ciliare*, and *Bouteloua curtipendula*. The

Table 12.—Frequency of occurrence of characteristic combinations of plant species, Sampson and Phegley hill prairies.

NUMBER OF QUADRATS	SIZE OF QUADRATS	SAMPSON COMBINATION*		PHEGLEY COMBINATION†	
		Number of Occurrences	Per Cent of Occurrence	Number of Occurrences	Per Cent of Occurrence
9	1	9	100.0	9	100.0
36	1 4	31	79.5	30	83.3
16	1 16	15	93.8	2	12.5
64	1 64	19	29.7	1	1.7
64	1 256	2	3.2	0	0.0

* Combination in Sampson hill prairie: *Andropogon scoparius*, *Solidago nemoralis*, *Houstonia nigricans*, and *Desmodium ciliare*.
† Combination in Phegley hill prairie: *Andropogon scoparius*, *Solidago nemoralis*, *Desmodium ciliare*, and *Bouteloua curtipendula*.

distribution among species. In the one (C), with a small number of plots and 13 species, 7, or 53.85 per cent, attained a percentage of 50 or more; in the other (D), with a large number of plots and 18 species, 7, or 38.88 per cent attained a percentage of 50 or more. In Sampson prairie, the frequency study showed, plots of 1 64 to 1/4 milacre were of sufficient size to give a satisfactory distribution of species.

Phegley Prairie.—Table 11 summarizes the data for the frequency study in grazed Phegley prairie. As in Sampson, the 1 256-milacre size was much too small to give good distribution; only *Andropogon scoparius* attained a high frequency percentage. The 1 64-milacre size did not give good distribution of species; only two, *A. scoparius* and *Solidago nemoralis*, attained percentages of 50 or more. These species represented 13.33 per cent of the total found in the 64 plots of this size. In Phegley prairie, the frequency study showed, plots of 1/16 to 1/4 milacre were of sufficient size to give a satisfactory distribution of species.

frequency values for these combinations of species are summarized in table 12. For the two larger plot sizes, 1/4 and 1 milacre, the sample was the 9-milacre square. For the 1 64- and 1/16-milacre sizes, the sample was the central milacre of the 9-milacre square. For the 1/256-milacre size, the sample was 1/4 milacre, the northwest quarter of the central milacre. If the 1 4-milacre size had been studied in only the central milacres, the percentage of occurrence of the characteristic combinations for both Sampson and Phegley would have been 100.

Wherever one or more combinations of species can be discerned in any particular type of vegetation, the combinations can serve as a criterion of adequacy of plot size. In Phegley prairie, the 1/16-milacre size was obviously too small to give a fairly high frequency of occurrence for the characteristic combination; in Sampson prairie, the 1/64-milacre size was too small.

Frequency of occurrence of characteristic combinations of species has been used as a test of the adequacy of size of sam-

ple in one study known to the writer: the forest study by Vestal & Heermans (1945).

Species-Area Curve.—A species-area curve can be constructed from data obtained from the species list for the various plot sizes. The maps of the central mil-acres, figs. 8 and 9, furnished the data for deriving average numbers of species in quadrats of 1/256-, 1/64-, and 1/16-mil-acre sizes. Species lists, compiled by 1/4-mil-acre units, for each of the 9-mil-acre squares furnished the data for computing the averages for quadrats of 1/4- and 1-mil-acre sizes. The total number of species found in the 9-, 25-, 40-, 50-, 65-, and 75-mil-acre areas provided the figures for the larger plot sizes. These data are shown in table 13.

When the data are plotted on semilogarithmic paper, the resulting curves are S-shaped, fig. 13. From this type of curve, certain reference areas can be determined with the method described by Vestal (1949). These are (1) the smallest representative area, (2) the minimum area for assignment to type, after this referred to briefly as minimum area, and (3) the

Table 13.—Numbers of plant species in plots of various sizes, Sampson and Phegley hill prairies.

PLOT SIZE, MILACRES	NUMBER OF SPECIES*	
	SAMPSON PRAIRIE	PHEGLEY PRAIRIE
1/256.....	2.11	1.98
1/64.....	3.79	3.94
1/16.....	6.56	7.13
1/4.....	7.33	9.27
1.....	11.22	13.44
9.....	18.0	26.0
25.....	21.0	20.0
40.....	—	28.0
50.....	20.0	—
65.....	—	29.0
75.....	24.0	—

* The average number of species per quadrat for plot sizes of 1 mil-acre and smaller; total number of species in larger quadrats.

area of fair-sized stand. The smallest representative area (*Ar*) is the smallest one-piece area having some claim to be representative. It is the effective plot-size of Vestal & Heermans (1945). The minimum area (*Am*), a plot-size that is large enough to include all the important

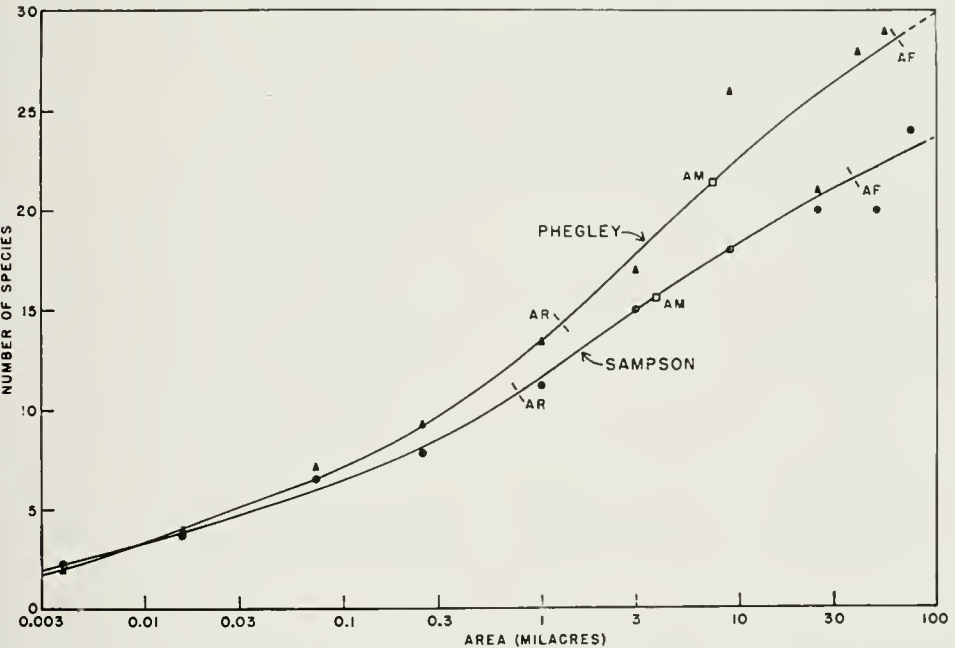


Fig. 13.—Species-area curves for Phegley (grazed) and Sampson (ungrazed) hill prairies. *Ar*, smallest representative area; *Am*, minimum area for assignment to type; *Af*, fair-sized stand.

and a moderate number of minor species, is an area 5 times as large as the smallest representative area and usually contains 1.44 to 1.5 times as many species. It is the smallest size to be used if a single one-piece sample is to be examined. The fair-sized stand (Af) is an area 50 times as large as the smallest representative area and contains twice as many species.

For Sampson prairie, the curve indicates the smallest representative area to be 0.76 milacre, with 10.8 species; the computed minimum area 3.80 milacres, with 15.6 species, or 1.444 times as many species as in the smallest representative area; the fair-sized stand 38.0 milacres, with 21.6 species.

For Phegley prairie, the curve indicates the smallest representative area to be 1.26 milacres, with 14.3 species; the computed minimum area 6.30 milacres, with 21.4 species, or 1.497 times the number in the smallest representative area; the fair-sized stand 63.0 milacres, with 28.6 species.

The 9-milacre square was larger than the smallest representative area and minimum area for both prairies. Both prairies were of more than sufficient size to qualify as fair-sized stands. The number of species in 1 acre was estimated to be 28.0 in Sampson and 35.2 in Phegley.

Summary of Pastured and Unpastured Prairies.—Some of the differences in vegetation of the pastured and the unpastured hill prairies are here summarized.

1. The number of species in a quadrat was larger in the pastured than in the unpastured hill prairie.

2. Plant density, based on the number of plants in a quadrat, was smaller in the pastured than in the unpastured prairie; the grass bunches were smaller, less vigorous, and not so tall.

3. Grasses constituted a smaller percentage of the total number of individual plants in the pastured prairie than in the unpastured.

4. The ground space occupied by grasses was smaller in the pastured prairie than in the unpastured.

5. Foliage area, or crown cover, was understandably much smaller in the pastured than in the unpastured prairie. Also, the ratio of crown cover to ground space

was smaller in the pastured prairie than in the unpastured prairie.

Vegetation Characters From Other Stands

In the preceding section, some analytic characters of vegetation were described for two hill prairie stands, Sampson and Phegley prairies. Analytic characters of vegetation, according to some phytosociologists, are those traits which are studied in each stand. Synthetic characters of vegetation are those which are studied from comparisons of large numbers of stands. Presence, a synthetic character of vegetation, and seasonal aspect, also synthetic in that it was described from observations made on most of the stands of Illinois hill prairies, are here briefly presented.

Presence.—Presence, as used here, is defined as the more or less persistent occurrence of a species in the stands of a plant community. Used for this study were 36 stands of hill prairies that the writer visited at least twice during the field work. From species lists of the 36 stands, a table was devised which lists the species and the stands in which they occurred, table 14. Species of forests or thickets and those of foreign origin were not included in the table unless they occurred in 18 or more of the stands.

Three species were present in 90 per cent or more of the stands. They were *Andropogon scoparius*, *Erigeron strigosus*, and *Bouteloua curtipendula*. Six species were present in 80 to 89 per cent of the stands. They were *Petalostemum purpureum*, *Euphorbia corollata*, *Penstemon pallidus*, *A. gerardi*, *Verbena stricta*, and *Kuhnia eupatorioides*. These nine species were the "constants" of the association; they can be classed as "constantly present." The "commonly present" species, that is, those present in 60 to 79 per cent of the stands, were *Eupatorium altissimum*, *Rhus glabra*, *Oxalis violacea*, *Solidago nemoralis*, *Panicum scribnerianum*, *Aster oblongifolius*, and *Ruellia humilis*. Species in 50 to 59 per cent of the stands were *Linum sulcatum*, *Lithospermum incisum*, *Melilotus alba*, *Lespedeza capitata*, *Pycnanthemum pilosum*, *Poa pratensis*, *Psoralea tenuiflora*, *Cassia fascicu-*

lata, and *Sorghastrum nutans*. Thus, in 50 per cent or more of the hill prairies, there were 25 species present. All are natives of North America except one, possibly two. *Melilotus alba* is Eurasian. *Poa pratensis* is generally considered European by many authorities, but Gleason (1952) states, "In most of our range introduced from Europe; along our n. boundary and in Canada it may be native." It might prove difficult to determine whether Illinois plants of this species had their origin in Europe or Canada.

Species most characteristic of the hill prairie type are *Bouteloua curtipendula*, *Psoralea tenuiflora*, *Petalostemum candidum*, *Linum sulcatum*, and *Lithospermum incisum*. The presence of these species in other prairie types in Illinois is much lower than in hill prairie.

Seasonal Aspect.—The Illinois hill prairies studied in the years covered by this report showed certain seasonal aspects.

In winter, the brownish color of the grass cover predominated. On some ungrazed hill prairies, tall grass stems of the previous growing season bent over and trended downslope to form a fairly complete cover over the soil. Small purplish rosettes of *Solidago nemoralis* and green rosettes of *Senecio plattensis* were evident between the grass clumps in some of the prairies.

The prevernal aspect was mostly brown. In early April in some prairies, the small white flowers of *Draba reptans* were seen. By late April, the violet flowers of *Oxalis violacea*, the yellow-orange blossoms of *Lithospermum canescens*, and the yellowish flowers of *Salix humilis* and *Rhus aromatica* were evident among the grass bunches.

In the vernal phase, the dominant color changed from brown, through brownish-green, to green as the grasses began their growth. *Hedcoma hispida*, with very small bluish blossoms, was common in the interspaces in many prairies. *Erigeron strigosus*, taller than the grasses during the vernal phase, was very conspicuous with its white flowers, as was also *Pentstemon pallidus*. *Tradescantia*, with purple blooms raised above the level of the grasses, was scattered in many prairies.

The yellow rays of *Senecio plattensis* and *Coreopsis lanceolata* were conspicuous in some. Several grasses, *Panicum scribnerianum*, *Poa pratensis*, *Festuca octoflora*, and *Koeleria cristata*, flowered at this time.

In the aestival stage, the predominating color was green or purplish-green. *Echinacea pallida*, with purplish rays, was in bloom, and *Linum sulcatum*, with small yellow petals, began its flowering. In some prairies the small whitish flowers of *Houstonia nigricans* were frequent. The inflorescences and foliage of *Psoralea tenuiflora* gave some prairies a purplish-green hue, especially in early July. The purple-flowered *Buchnera americana* and *Petalostemum purpureum* and the white-flowered prairie-clover, *P. candidum*, were scattered in some prairies. In late June and early July, the green or purplish-green inflorescences of *Bouteloua curtipendula* appeared. In the latter part of July and early August, the bronze, green, or purplish-green inflorescences of *Andropogon scoparius* and *A. gerardi* were conspicuous. By late August, the yellow of *Solidago nemoralis* and the purple of *Liatris aspera* were evident.

In the autumnal phase, beginning in September, the dominant color changed from green to brownish hues. The yellow rays of *Solidago nemoralis* and the white or purple rays of several species of *Aster* were common. By October, very few plants, an occasional *Solidago* or a *Houstonia*, or, less often, a *Spiranthes*, were still in flower. By November the prairie was again dormant; the dominant grass cover was brown.

VEGETATIONAL HISTORY AND SUCCESSION

The vegetational history of Illinois, a state that is within the area of overlap of eastern prairie and forest, is deduced mainly from circumstantial evidence. The evidence is derived from the present flora and vegetation, especially from apparent relict colonies, from fossils in the loess, and from analyses of pollens and fossils in peat and lacustrine deposits. Deductions must conform not only to the facts of botany but also to the facts of meteorology

and geology. In making deductions concerning plant succession and vegetational history of Illinois hill prairies, it is necessary to keep in mind some of the Pleistocene history of the area in which these prairies occur.

The strip of land along the present Mississippi River valley in western Illinois has had a vegetational cover since Kansan glacial times, fig. 4, except for the portion from southern Carroll County to northern Adams County, inclusive, which was covered by ice during part of Illinoian glacial time. Except for a strip between Fulton, Whiteside County, and Cordova, Rock Island County, which was covered during Tazewell glacial time (Shaffer 1954), the entire western border has supported a plant cover since Sangamon interglacial time. It was during Tazewell time that the present valley of the Mississippi from the Rock Island area south to Adams County was established. The eroding valley perhaps did not maintain a continuous plant cover but the adjacent uplands did; their cover was probably prairie.

The Illinois River valley south from the "Big Bend" at De Pue was established in pre-Pleistocene time and has been occupied by vegetation since Illinoian deglaciation except for the area from Peoria northward, which was glaciated again during Tazewell time. The Rock River hill prairie site included in this report was not covered by ice after Farmdale glacial time. The area along the valley of Sangamon River near its mouth was last glaciated during Illinoian time.

It seems entirely possible that during the Tazewell substage, when the ice-front was at the Shelbyville moraine, a fairly steep climatic gradient prevailed, with climatic conditions along the valleys in western Illinois not very different from those of the present. Loess deposition occurred during the time of advance, maximum extent, and recession of the glacial ice. The major deposition doubtless took place in the autumn and winter, which were then, as now, the dry seasons of the year. Loess deposits of Kansas contain fossil snails that point to a plant cover for that area at the time of deposition that consisted of shrubs and herbaceous spe-

cies (Leonard 1952) and of a forest border near the Missouri River (Leonard & Frye 1954). As the Kansas deposits are of comparable age to those of Illinois, a similar plant cover may have existed in parts of Illinois. The vegetation in much of western Illinois west of the Tazewell ice-front may be imagined as that of a prairie or grassland (Gleason 1923). The floodplains were devoid of plant cover because of the constant shifting of the overloaded streams with their braided channels. During the dry autumnal and winter seasons, the floodplain served as a source of silt, which was transported to the uplands by the then, as now, prevailing northwest winds.

While separating bunch-grass clumps from Reavis Spring to expose individual plants (page 381), Vestal and the writer observed that vigorous upward growth of plants had kept pace with the deposition of additional sandy material. From such observations it can be concluded that, along the bluffs, deposition of loess favored rather than discouraged the growth of bunch grasses. The inverse also was true; a grass cover favored the catching and holding of windblown silts (Shimek 1903). As new areas were exposed by deglaciation (for instance in the Putnam County hill prairie locations), the prairie species, because of proximity and the rapidity with which many of them could become established, moved in and occupied the bluffs before woody plants could do so. Mosses and lichens were not the first plants to become established in areas of deglaciation. On present-day loess and till slopes in Illinois, these cryptogamic species are absent from sizable areas without vascular plants but are present in some interstices where grass plants give some protection. A similar situation probably prevailed during deglaciation. Prairie vegetation thus can be assumed to have long antedated tree cover on many of the bluffs of the larger rivers in Illinois. The advantage of priority of occupation is probably far more important in succession than is commonly realized.

Although subsequent history has perhaps been one of progressive encroachment by forest on many of the Illinois bluffs, especially those of low altitude, several

stretches of bluff frontage, totaling 25 to 30 miles, remain hill prairie or are in part hill prairie. Possibly as much as three times this extent, 75 to 90 miles, or about one-eighth of the bluff frontage on the east sides of the major stream valleys, was prairie in the early nineteenth century, but was converted to pasture or otherwise disturbed by the activities of man. The bases for such an estimation are the few scattered prairie plants along stretches of bluffs now occupied principally by bluegrass and numerous pasture weeds. Such stretches of bluffs are common along the Mississippi River in Jo Daviess County. Doubtless these bluffs were prairie covered in the not distant past.

Hill prairies have been surprisingly successful in resisting destruction by the grazing of domestic animals and by some of the activities of man. There are no records to show how heavily these prairies were grazed by bison before the arrival of white men in Illinois. It is possible that bison grazed many hill prairies, but that they failed to reach some that were hidden by surrounding dense forest. Whether or not pastured hill prairies observed for this report are being reduced by overpasturing is not yet evident. Goat pasturing in one site along the bluffs of the Illinois River south of Rosedale caused complete destruction of the prairie, leaving only bare loess on the slope. The spread of residential and industrial areas has destroyed some of the hill prairies. On the other hand, it is evident that fire has not destroyed them; seemingly, it has permitted an earlier and more tender growth of grass.

What is the probability that hill prairies are now being invaded by forests? Some of the most typical hill prairies are located on brow slopes where the cliffs are so high that they extend above the trees that grow on the toe slopes; without the shade of the trees, the brow slopes, especially those facing southwest, are exposed to the heat of the sun and to the prevailing winds of summer and are thus too xeric for growth of mesophytic forest and will probably remain prairie. The bluff coves, which serve as drainageways on the slopes, are more mesic and, in places, support mixed forest. Such forested coves contain tree

species that are found in the forests of the basal slopes, of the slopes of the tributary valleys parallel to the main valleys, or of the uplands. Where the bluffs are low, or in the few places where the ascent from floodplain to upland is continuously of low gradient, trees have long shaded the upper slopes and greatly reduced wind movement. In such situations, forests have been established over entire slopes.

In years of abundant rainfall, forest seedlings become established on prairie spurs, only to die in years of less abundant rainfall or in periods of successive dry years, as of the 1930's. Dwarfed trees, as well as dead sumacs and red cedars, are reminders of dry years and a contest between forest and prairie. It thus seems probable that a shifting equilibrium was long ago reached between prairie and forest, especially on bluffs with high cliffs. As long as the present topography and climate persist, such hill prairies will remain approximately as they are.

Delimitation and description of the actual stages of succession within hill prairie areas cannot be made now, but must await the advent of interested botanists of the future. In the interim, it is important that botanists continue the study of these sites and publish the results of their studies. From such studies, botanists will be able to trace actual, not hypothetical, paths of succession and also deduce with a greater amount of accuracy the past vegetational history.

ANNOTATED LIST OF HILL PRAIRIES

The following list of Illinois hill prairies includes only those prairies which the writer visited during the field work for this study. The name given to each of the prairies was derived from one of several sources—the name of the landowner, or of the tenant, or of the farm on which the prairie was found; the name of that stretch of bluff occupied by the prairie; or the name of some nearby landmark or community as applied locally or found on a quadrangle of the United States Geological Survey topographic map. Location of each prairie is given according to

section, town, and range except for prairies within municipalities, state parks, or the old French land grants. These grants extended inland at right angles to the bank of the Mississippi River and were not surveyed according to the township system. In this hill prairie study, such grants were encountered in Monroe and Randolph counties.

For convenience in listing, the prairies are divided into three groups, (a) those along the Mississippi River from East Dubuque to Grafton, (b) those along the Rock, Sangamon, and Illinois rivers, and (c) those along the Mississippi River from Grafton to Cairo and elsewhere in southern Illinois. On the bluffs south of Warsaw, Hancock County, were several small openings which were seen but not examined for this study. Also, on the south side of the lower Sangamon River valley were a number of hill prairies, some with north- and northwest-facing slopes. Many of these prairie slopes served as pastureland and were much disturbed. Some of the slopes were completely converted to bluegrass pastureland. None of these slopes was visited. Fig. 1 shows the locations of these hill prairie sites. Not described, nor indicated in fig. 1, are several pastured grass slopes on the bluffs of the Mississippi River, west and south of Galena, Jo Daviess County, which were visited June 15-16, 1950. At that time they were covered with many weeds and they contained few prairie plants.

East Dubuque to Grafton

El Rancho.—This prairie, located on the bluff above the El Rancho Café in East Dubuque, Jo Daviess County, was visited July 16 and October 4, 1950; May 9 and June 14, 1951. Prairie, slightly over an acre in area, covered the stony part of the slope above the cliff, and also the loess on that part of the slope above the stony part. The uppermost part of the slope and the generally flat bluff-top, greatly disturbed by the WPA in constructing stone foundations for a fireplace and two shelters, had been much trampled and was weedy. Two Indian mounds crowned the spur nearest the café. A forested cove separated this spur from

another to the south. Three Indian mounds occupied the crest of the southern spur. *Andropogon scoparius* was the dominant grass of both spurs; *Stipa spartea* grew in large patches on the south spur and was in smaller, scattered patches on the north spur.

Menominee Station.—This prairie, in the southwest quarter of section 17, T. 27 N., R. 1 W., on the bluffs of the Mississippi River, about one-half mile southeast of Menominee Station, Jo Daviess County, was visited October 4, 1950; May 9 and June 14, 1951. Prairie covered about 4 acres on parts of four southwest-facing spurs. Rock fragments covered the surface for a few yards above the rock ledge; loess capped the bluff. *Andropogon scoparius* was the dominant grass. The northeast-facing slope of the northernmost spur and the uplands adjoining the remaining spurs supported a mixed forest. *Rhus glabra* formed dense stands on three spur-tops, and it extended downslope on the north sides of these spurs. *Populus tremuloides* occupied a part of the crest of the northernmost spur of this prairie.

North Savanna.—Prairie covered the upper southwest- and west-facing slopes of the bluff-ridge in section 21, T. 25 N., R. 3 E., 3 miles north of Savanna, Carroll County, when the site was visited June 14, 1951. On the slopes above the rock ledge, *Bouteloua hirsuta* was abundant. Disturbed prairie covered the crest of the ridge. Northward along the ridge, the slope and top were occupied almost entirely by *Juniperus virginiana*.

Sunset Trail.—At the time this study was made, prairie occupied one northwest-facing spur, three west-facing spurs, and one south- to southwest-facing spur on the bluff north of the Administration Building in the Mississippi Palisades State Park, north of Savanna, Carroll County. A trail, Sunset Trail, crossed parts of this prairie. *Andropogon scoparius* and *Bouteloua curtipendula* were abundant grasses. Sandy loess covered the northwest- and west-facing slopes; the south-facing slope was stony. The stony slope was not so steep as the loess slopes. These spurs were visited October 4, 1950, and June 14, 1951.

Hill-Top.—This prairie opening, when examined October 5, 1950, occupied about 4.5 acres on the uppermost surface of the bluff, one ravine south from the main entrance to the Mississippi Palisades State Park. A mixed forest surrounded the prairie. *Sorghastrum nutans* was the dominant grass; *Panicum virgatum* was abundant. Several paths crossed the prairie. Here and for a short distance into the prairie, weeds were common.

South Palisades.—This prairie occupied about 0.2 acre of the generally stony southwest-facing ridge-slope north of the abandoned quarry near the southern boundary of the Mississippi Palisades State Park, when observations were made there on June 22 and October 5, 1951. *Andropogon scoparius* was the dominant grass.

Bielema.—Prairie occupied slightly more than an acre of the bluff on the Bielema farm in section 32, T. 23 N., R. 4 E., southeast of Thomson, Carroll County, in 1950. Stones strewn the lower slope; sandy loess comprised the upper. The base of the lower slope, much disturbed by pigs, was weedy. Prairie, with *Bouteloua curtipendula* and *Andropogon scoparius* as dominant grasses, covered the upper part of the rocky slope. *Andropogon scoparius* was the dominant grass on the sandy loess, except where shallow drainageways on both the stony and loess slopes were densely covered by *Artemisia caudata*. *Poa pratensis* was the dominant cover on the northern part of the bluff-top; *Bouteloua curtipendula* dominated the southern part of this surface. Bielema prairie was visited June 23 and October 6, 1950.

Balk.—In 1951, two conspicuous prairie openings, together about 1 acre, were observed on the upper west-facing slope of the bluff-ridge in section 5, T. 22 N., R. 4 E., in Whiteside County. The southern opening and the surrounding forest were frequented by pigs; the northern opening, which was separated from the southern by a fence, was unpastured. *Bouteloua hirsuta* and *Stipa spartea* occurred in these openings. This site was visited June 13, 1951.

Wiersma.—Hill prairie, about 0.5 acre in area, occupied the upper west-facing

slope of the bluff-ridge on the Wiersma farm in section 8, T. 22 N., R. 4 E., Whiteside County, in 1950. *Bouteloua curtipendula* was apparently the dominant grass; *Andropogon scoparius* was locally abundant. The entire ridge was heavily pastured. Wiersma prairie was visited October 6, 1950.

Rock Island 31.—This site, located in section 31, T. 16 N., R. 5 W., Rock Island County, was visited September 9, 1949. The slope, heavily pastured, and covered with a mixture of prairie and forest, was stony below and capped with sandy loess. *Andropogon scoparius*, *A. gerardi*, *Sorghastrum nutans*, and *Bouteloua hirsuta* were some of the grasses on this slope.

Bald Bluff.—The name denotes the prominent, narrow, northwest-projecting arm of the Mississippi bluffs in section 18, T. 12 N., R. 4 W., Henderson County. Mantled with sandy loess, Bald Bluff supported both mixed forest and prairie when visited. This prairie, with an abundance of *Bouteloua hirsuta* and many weedy species, was heavily pastured. Prairie covered about 9 acres, 3 of which were examined on August 18, 1951.

Ursa.—When visited, this hill prairie occupied the southwest- and west-facing slopes on the north side of Ursa Creek valley where the creek enters the Mississippi River bottomland in section 13, T. 1 N., R. 9 W., Adams County. Prairie covered about 1 acre of the slopes. A stony levee and small spring-fed stream separated the road on the west from the bluff to the east. The stony east bank of the stream supported prairie. Small rock outcrops capped the stream bank. Above these outcrops the surface was almost level. A dense stand of *Juniperus virginiana* with scattered individuals of *Quercus muhlenbergii* and *Cornus drummondii* grew on the level surface near the limestone outcrops. Eastward there was a narrow belt of prairie and beyond that a thicket which included small oaks, basswood, and hop hornbeam. This thicket bordered the base of a steep loess spur which was covered by prairie up to the top of the bluff. Prairie covered the southwest-facing spurs, mixed forest the coves. The bluff-top was a mixture of

prairie and sumac. Ursa prairie was visited August 11 and September 9, 1950; June 2 and July 14, 1951.

Rock Creek.—Located north of Rock Creek, in the northwest quarter of section 25, T. 1 N., R. 9 W., Adams County, this prairie when visited covered more than an acre of a ridge of sandy loess. *Andropogon scoparius* was the dominant grass; *A. gerardi* and *Bouteloua curtipendula* were present. *Asclepias stenophylla* and *Chenopodium leptophyllum* occurred in the interspaces. *Psoralea tenuiflora* was common on the gentle lower slope and the almost level top, but was infrequent on the steeper slopes. Rock Creek prairie was visited September 8, 1949; August 11, 1950; April 25, June 2, and July 14, 1951.

Homan.—This name, which is also the name of the creek to the east, here designates the small hill prairie that in 1951 occupied slightly more than an acre in section 11, T. 1 S., R. 9 W., about 3 miles north of Quincy. Prairie covered the west- and southwest-facing slopes of the southern tip of a ridge that ends at Homan Creek. The crest of the ridge was almost covered with *Rhus glabra*, *Psoralea tenuiflora*, *Petalostemum candidum*, and *Melilotus alba*. A few individuals of *Asclepias stenophylla* and *Delphinium carolinianum* occurred there as well as on the slopes. Vegetation of the east-facing slope was principally a mixture of prairie and sumac. *Andropogon scoparius* dominated the west- and southwest-facing slopes. *Bouteloua curtipendula* occurred in scattered patches. This site was visited on April 25, June 2, and July 16, 1951.

Parker Heights.—This small hill prairie, which occupied the south part of a ridge in Parker Heights, a park about a mile north of Quincy, Adams County, was visited May 28, 1950, and July 16, 1951. Disturbed prairie, much trampled by people, covered the west- and southwest-facing slopes above the exposed limestone bedrock.

Hidden Lake.—The pond within the quarry in the southeast quarter of section 23, T. 2 S., R. 9 W., about 2 miles south of Quincy, provided the name for this site. A wall of limestone which forms

the north and east limits of the lake is covered with a thick mantle of loess to form the bluff. Above the bedrock, the mantle of loess forms an almost vertical cliff with heights to 15 feet, and above the loess cliff is the gentle west- and southwest-facing brow slope of the bluff. Hidden Lake prairie, when visited September 8, 1949, and May 28, July 2, August 13, and September 9, 1950, covered about 0.2 acre of this slope. The steep loess face was almost without vegetation except at its junction with bedrock. Small shrubs occupied this junction. The prairie had been much disturbed by human trampling, because the site attracted numerous boys from nearby Quincy. *Andropogon scoparius* was dominant on the slopes. A dense stand of *Rhus glabra*, *Melilotus alba*, and *A. scoparius* occupied the crest of the ridge. *Tridens flavus* was frequent.

Seehorn Cemetery.—This prairie, located on the uppermost slope of the bluff, in the southeast quarter of section 26, T. 3 S., R. 8 W., Adams County, was visited September 9, 1950. Prairie occupied the cemetery and some of the slope to the northwest and southeast. Downslope there was a mixed forest; upslope a bit of prairie was found between the cemetery and the cultivated upland. *Sorghastrum nutans* was the dominant grass. *Andropogon gerardi*, *Bouteloua curtipendula*, and *Psoralea tenuiflora* were common.

Fall Creek.—This prairie in 1950 occupied the bluff about one-quarter mile south of Seehorn Cemetery prairie. Mixed forest occupied the coves; forest, or a mixture of prairie and forest, covered the spurs. *Andropogon scoparius*, *A. gerardi*, and *Sorghastrum nutans* appeared equally abundant. Interspaces between the hunches of grass were small. This area was visited September 9, 1950.

North Pandarmie.—This name designates a group of spurs and coves on the bluffs in section 31, T. 3 S., R. 7 W., and section 36, T. 3 S., R. 8 W., north of Pandarmie Hollow, 2.5 miles southeast of Fall Creek, Adams County. When North Pandarmie was visited September 9, 1950, forest occupied the coves; a mixture of prairie and forest covered the spurs. *Andropogon gerardi* and *Sor-*



Fig. 14.—Housen hill prairie, north of Rockport, Pike County. The forest of the basal slope extends to the bluff top through the drainageway at the left of the prairie.

ghastrum nutans were abundant; *A. scoparius* was infrequent. At the top of the brow slope was a strip of woodland. Its northeast side had a dense border, 3 to 6 feet wide, of *Sorghastrum*. At the base of the spurs, *Mentzelia oligosperma* grew in the crevices of the interrupted rock ledge.

Seehorn-Payson.—The name of this hill prairie comes from a village in Pike County and a township in Adams County. In 1950, prairie occupied about an acre of slope; part of this area was in the southwest quarter of section 31, T. 3 S., R. 7 W., Adams County, and part in section 6, T. 4 S., R. 7 W., in Pike County. *Astragalus distortus* occurred on the loess and on the rock ledges. *Mentzelia oligosperma* grew on the rock ledges and the rocky slope above the ledges. The prairie was heavily pastured by cattle and sheep. *Poa pratensis* was the most abundant grass on the prairie slopes; *Andropogon scoparius* was infrequent. In September, 1950, very little of the herbaceous vegetation was more than 6 inches tall; the average was 3 to 4 inches, except for an occasional bunch of *Bouteloua curtipendula*. This prairie was visited May 28, July 2, and September 9, 1950.

Sessions.—In the 3 years this hill prairie was under observation, it occupied

about 4.5 acres of the upper southwest- and south-facing slope of the bluff in section 5, T. 5 S., R. 6 W., on the Sessions farm between Kinderhook and New Canton in Pike County. Prairie covered seven spurs, mixed forest the intervening coves. Above the rock ledge was a stony slope covered with prairie. Loess mantled the bluff. There was a generally flat upland to the northeast of the slope. Prairie covered the almost flat spur-tops and some of the flat upland to the northeast. Much *Rhus glabra* grew on this flat surface and at the heads of the south-facing coves. *Andropogon scoparius* was the dominant grass. The entire site served as a pasture. Visits were made to Sessions hill prairie on September 7, 1949; May 28, July 2, September 8, 1950; and April 24, 1951.

South New Canton.—A small hill prairie, less than 1,000 square feet in area, in 1950 occupied the southwest-facing bluff slope southeast of Morey Cemetery, about a mile southward along the bluffs from New Canton, Pike County. A rocky slope lay above the rock ledge, and loess capped the bluff. *Andropogon scoparius* was the dominant grass. *Mentzelia oligosperma* grew abundantly in the crevices and recesses of the ledge and infrequently on the lower part of the loess slope. The entire bluff and the upland ridge to the

northeast was pastured and much disturbed. Visits were made to this site on May 27, July 1, and September 8, 1950.

Housen.—When visited April 24, 1951, this hill prairie in the southeast quarter of section 7, T. 6 S., R. 5 W., on the Housen farm north of Rockport, Pike County, covered more than an acre of the uppermost southwest-facing slope of the

crest of the ridge grew a mixture of prairie, woodland, cultivated plants, and weeds. Some of the plants growing in this site were *Lespedeza stipulacea*, *Symphoricarpos orbiculatus*, *Melilotus alba*, *Tridens flavus*, *Bouteloua curtipendula*, *Andropogon scoparius*, *A. gerardi*, *Verbena stricta*, and *Eragrostis cilianensis*. The inner, or northeast, slope of the ridge sup-



Fig. 15.—The Clendenny hill prairie, northwest of Bellevue, Calhoun County. *Buchnera americana* was common in parts of this prairie.

ridge shown in fig. 14. *Andropogon scoparius* was the dominant grass; *A. gerardi* and *Bouteloua curtipendula* were present. The prairie and a part of the adjacent woodland on the slope to the northeast were burned during the autumn of 1950 by a fire that swept the bluffs from Rockport northward to a point beyond this prairie.

Clendenny.—When last seen, this hill prairie, located in the northwest quarter of section 12, T. 8 S., R. 4 W., about 2.3 miles north of Bellevue, Calhoun County, covered about 7 acres of the uppermost southwest-facing slope of a bluff. This bluff, fig. 15, served as the pasture of the Clendenny farm. Prairie covered the rocky slope above the rock ledge except in a few coves where a mixed forest extended upslope. Loess capped the bluff. Prairie covered the spurs and most of the coves; small trees and shrubs grew in scattered clumps in some coves. On the

ported both forest and prairie: mixed forest on the northwest part and a mixture of prairie and forest on the southeast part. Clendenny prairie was visited April 15, May 27, and September 8, 1950; August 30 and September 27, 1951.

Swarnes.—An inscription on the monument* at the crest of the bluff in the northeast quarter of section 35, T. 9 S., R. 3 W., at the north limits of Hamburg, Calhoun County, furnished the name for this hill prairie. When the site was last seen, prairie occupied about 2 acres of the west- and southwest-facing slope of the ridge. A fence located a few feet north

*The following inscription appears on this monument:
In Memory of
Capt. Lewis Swarnes
Born
May 23, 1821
Died
July 11, 1867.

Lewis Swarnes, according to several residents of Hamburg, was a riverboat captain. He became ill on one of his trips and requested that his body should be buried on the bluff overlooking the Mississippi River at Hamburg.



Fig. 16.—Part of the west-facing slope of Swarnes hill prairie at Hamburg, Calhoun County. *Echinacea*, *Melilotus*, and *Psoralea* were common on this slope.

of the monument divided the prairie almost equally into pastured and un-pastured areas. The pastured segment occupied a west-facing slope, fig. 16, the un-pastured a west- and southwest-facing slope. The un-pastured surface that bordered the rock ledge was stony, level near the ledge, and gradually steepening upward from the ledge. *Bouteloua curtipendula* was there locally dominant. Interspaces contained many individuals of *Houstonia nigricans*. The un-pastured prairie of the steeper slopes and the top of the loess-capped bluff were dominated by *Andropogon scoparius*. Scattered clumps of *Bouteloua curtipendula* and *A. gerardi* were present, and *Asclepias stenophylla* occurred occasionally in the interspaces. The pastured slope supported a prairie that was dominated by *A. scoparius*. Near the top of the bluff, as well as at the top, *Rhus glabra* was locally dominant. *Psoralea tenuiflora* was common in the pastured prairie area. Swarnes prairie was visited September 7, 1949; April 14, May 27, July 1, and August 12, 1950; and September 27, 1951.

Along Rock, Sangamon, and Illinois Rivers

Devil's Backbone.—The bluff-ridge that extends along the Rock River in the northeast quarter of section 16, T. 23 N., R. 10 E., south of Oregon, Ogle County, is given the name Devil's Backbone on the Dixon quadrangle of the United States Geological Survey topographic map. St. Peter sandstone underlies this ridge. When the ridge was last seen, one south-east- and two northeast-facing prairie openings occupied the upper stony and sandy slopes. Sandstone fragments were abundant on the northeast-facing slope. The openings on this slope were covered with prairie in which *Poa pratensis* was very abundant, *Andropogon scoparius* less abundant, and *Bouteloua curtipendula* scattered throughout. *Synthyris bulbii* also grew there. The southeast-facing opening was a sand prairie on a slope. *A. scoparius* was there the dominant grass. *Selaginella rupestris*, together with mosses and *Androsace occidentalis*, grew in the interspaces. Devil's Backbone was visited

on June 23 and October 3, 1950, and May 7, 1951.

Standard.—In 1951, prairie occupied about a half acre of the upper southwest-facing ravine slope in section 26, T. 33 N., R. 1 W., 1 mile west and 3 miles north of Standard Putnam County. *Petalostemum purpureum*, *Amorpha canescens*, and *Coreopsis palmata* were some of the plants in this prairie. This site was visited July 7, 1951.

Magnolia.—When the prairie opening given this name was last visited, it occupied slightly less than an acre on the west- to south-facing upper slope of the bluff in the southwest quarter of section 34, T. 31 N., R. 2 W., about 7 miles west of Magnolia, Putnam County. The bluff is capped with till; loess, if present, apparently is very thin. Scattered shrubs of *Rhus glabra* occurred throughout the opening. *Cornus drummondii* and small elms grew on the south-facing slope, where also a few dead and scattered stems of honey locust were seen. *Andropogon scoparius* was the dominant grass. *Comandra umbellata* was very abundant, *Psoralea tenuiflora* common. Mixed forest surrounded this prairie opening. Magnolia prairie was visited on September 29, 1949; May 16 and August 4, 1950.

East Henry.—This name designates a group of five prairie openings on the southwest-facing bluff of Sandy Creek; the bluff is in the northwest quarter of section 3, T. 30 N., R. 2 W., and southeast of Henry, Marshall County. When the area was visited August 4, 1950, the westernmost opening was weedy and much disturbed. At the base of the bluff below this opening was a gravel pit. The next opening eastward supported prairie plants and also a thicket of *Rhus glabra*, *Cornus drummondii*, *Malus ioensis*, and *Ulmus* sp. This opening and the next one to the east were pastured. In the prairie areas, *Andropogon scoparius* was the dominant grass, *Bouteloua curtipendula*, *Psoralea tenuiflora*, and *Silphium laciniatum* were common. Weeds, *Chamaesyce maculata*, *Medicago lupulina*, *Poinsettia dentata*, and *Melilotus alba*, were frequently encountered in these areas. Prairie openings on the two easternmost spurs were not examined.

Reavis Spring.—This prairie, when visited, covered almost 19 acres of the sandy loess bluffs in parts of sections 25, 26, and 36, T. 20 N., R. 7 W., about 5 miles south of Easton, Mason County. The name Reavis Spring was that of a school house, abandoned and later removed, that once occupied a part of the lower slope of the bluff in section 26. A road, which followed the general southwest-facing bluff, was on the lower sandy slopes. Downslope to the southwest was a series of thickets and cultivated fields. Upslope to the northeast was the prairie, which occupied numerous spurs. Thicket covered the bases of some coves, shrubs or prairie the upper slopes. Prairie covered the crests of the spurs; mixed forest or prairie occupied the tops of the bluffs.

The bluffs at Reavis Spring prairie rise 256 feet above the Sangamon River bottomland and are higher than the dissected upland to the northeast. The valley overlooked by these bluffs is notable in several respects. It has a wide bottom trending generally east-west. The Sangamon River enters it from the south and joins a small, west-flowing stream, Salt Creek, in section 6, T. 19 N., R. 6 W., about 1 mile upstream from the Reavis Spring location. The valley is about as wide, rather surprisingly, above the junction of the Sangamon River with the small stream as below it. Salt Creek has a volume too small to account for so wide a valley. It is probable that through this valley a glacial torrent once drained a part of the Wisconsin ice-front, then some miles east of the Reavis Spring site, and brought down huge amounts of sand and silt. From these were derived the thick deposits of loess and fine sand on the bordering bluffs. Other sizable hill prairies occur or did occur on the bluffs for a few miles east of the junction of Salt Creek with the Sangamon River.

Reavis Spring prairie was visited September 15, 1949; July 6, 1950; May 18, 1951; and March 25, 1952. The dominant grass was *Andropogon scoparius*. Also growing in the prairie were *Agoseris cuspidata*, *Polytaenia nuttallii*, and the easily overlooked *Spiranthes cernua*. The prairie, which served as a cow pasture, contained a number of weeds, *Verbascum*

thapsus, *Achillea millefolium*, and *Setaria viridis*. On the last visit it was found that the prairie had been burned a week before, fig. 17. From the tenant farmer it was learned that this prairie is burned in early spring each year to allow an ear-

Mud Creek.—In the years of this study, prairie occupied much of the sandy loess ridge that separates the bottomland of the Illinois River from Mud Creek in the northeast quarter of section 1, T. 16 N., R. 11 W., Morgan County. A thicket



Fig. 17.—Surface of Reavis Spring hill prairie after an early spring fire. The size of the clumps of *Andropogon scoparius* is evident by comparison with the 1-foot rule.

lier and more tender growth of grass than would normally occur.

Bluff Springs.—Disturbed prairie, which covered about a half acre on the north part of a loess mound in the southwest quarter of section 21, T. 18 N., R. 11 W., 0.1 mile north of Bluff Springs, Cass County, was visited September 15, 1949; July 6, 1950; and May 18, 1951. The mound and the adjacent lower slopes were pastured. The lower slope on the west was occupied by a mesophytic disturbed prairie with *Poa pratensis* locally dominant. The steeper slopes of the mound were prairie, with *Andropogon scoparius* the dominant grass. *Bouteloua curtipendula* and several plants of *Spiranthes cernua* occurred on these slopes. The almost level top, which had been much disturbed by trampling, supported a mixture of prairie and weeds.

bordered the road on the lower northwest-facing slope. This thicket extended into the coves and partly up the cove slopes. Prairie covered the spurs and ridge-top, fig. 18. The dominant grass was *Andropogon scoparius*. *Bouteloua curtipendula* and *B. hirsuta* grew in scattered clumps in the prairie, *Psoralea tenuiflora* was common, and *Sisyrinchium campestre* very abundant. All of this prairie and that part of the ridge that was covered with thicket, about 13 acres in area, served as a cow pasture. Visits were made to Mud Creek prairie on July 6, 1950; May 18, 1951; and March 25, 1952.

Northeast Meredosia.—When last seen, this prairie covered about 9 acres of the loess bluffs in section 9, T. 16 N., R. 12 W., about 6 miles northeast of Meredosia, Morgan County. *Andropogon sco-*

parius was the dominant grass. *Bouteloua curtipendula*, as well as *B. hirsuta*, was scattered throughout. *Polygala incarnata* grew on the bluff top, and *Artemisia caudata* grew as scattered individuals in the sandy loess. This prairie, which served as pastureland, was visited September 15.

Psoralea tenuiflora, *Onosmodium occidentale*, and *Ambrosia coronopifolia*.

Walnut Creek.—The site of this 2-acre prairie occupies one southwest- and two west-facing spurs of the bluff north of which Walnut Creek enters the Illinois River valley in the northwest quar-



Fig. 18.—Spurs of Mud Creek hill prairie (center of picture) in northwest Morgan County. In the distance beyond the Mud Creek prairie are slopes, some of which support prairie.

1949; July 6, 1950; May 18, 1951; and March 25, 1952.

Northeast Meredosia was the first of those hill prairies along the Illinois River observed by A. G. Vestal, who visited it in the spring of 1931 in company with James M. Schopf and Herman B. Wascher. They were impressed by the persistence of native prairie vegetation and by the lack of serious erosion on the steep loess slopes, over which the continuous trampling of cattle had worn steplike cowpaths.

Bluffs.—When this site was visited July 6, 1950, a mixture of prairie and forest covered about 8 acres of the west-facing slope of the bluff in the southwest quarter of section 10, T. 15 N., R. 13 W., north of Bluffs, Scott County. Prairie species included *Lespedeza capitata*,

ter of section 26, T. 14 N., R. 13 W., about 4 miles west of Winchester, Scott County. When visited August 13, 1950, and April 24 and May 18, 1951, the base of the slope contained a mixture of prairie and shrubbery. The spur slopes contained prairie, with *Andropogon scoparius* the dominant grass. The coves between the spurs supported prairie and some woody plants. The top of the ridge was very weedy. Walnut Creek prairie was used as a horse pasture.

North Eldred.—Located in section 16, T. 10 N., R. 13 W., 2 miles north of Eldred, Greene County, this prairie in 1949 and 1950 covered several spurs on the upper slope of the bluff. The spur directly above the cemetery at the base of the bluff was heavily pastured; the spurs to the south of this were also pastured but

not so greatly disturbed. Stones strewed the slope in places just above the rock ledge; sandy loess and sand capped the bluff. This prairie was visited September 1, 1949; April 14, May 23, and July 25, 1950.

South Eldred.—In 1950, prairie covered about 4.5 acres of two southwest-facing slopes in the southwest quarter of section 4, T. 9 N., R. 13 W., 2 miles south of Eldred, Greene County. The prairie formed an inverted U with the prongs of the U extending downslope. *Andropogon scoparius* was the dominant grass; *Senecio plattensis* and *Lithospermum canescens* were common. This site was visited May 23, 1950.

Richwood.—When last visited, this prairie, in the southeast quarter of section 8, T. 8 N., R. 13 W., Richwood Township, Jersey County, occupied 4 acres of the long, curved ridge which extends from the rock ledge on the southwest up to the bluff-top. The abundant grasses were *Andropogon scoparius*, *A. gerardi*, and *Bouteloua curtipendula*. A small arm of the prairie stretched northwestward on a small branch of the ridge. A mixed forest covered the bluff slope to the west and the ravines on the east and north. Richwood was visited September 7, 1949, and May 23, 1950.

Pere Marquette.—At the time of this study, prairie vegetation occupied about 3.5 acres on the spurs of the southwest-facing bluffs, Pere Marquette State Park, west of Grafton, Jersey County. The prairie observed for this study was on the slopes west of the westernmost parking area that was located on the crest of the bluff. Mixed forest grew in the coves between the grass-covered spurs. A little below the top of the eastern and central spurs a firebreak crossed the prairie. Weeds, including *Ambrosia elatior* and *Erigeron canadensis*, grew among scattered plants of prairie species in this firebreak. The dominant grass of the prairie slope was *Andropogon scoparius*. *Desmanthus illinoensis* grew on the western spur and was very abundant on the central one. The western spur was disturbed by a bridle path which followed the crest of the spur and had cut 2 feet into the loess. The bluff-top was covered by a

thicket of small trees and shrubs, including *Crataegus crus-galli*, *Cornus drummondii*, *Malus ioensis*, *Cercis canadensis*, and *Sassafras albidum*. Pere Marquette was visited July 8 and August 29, 1950; May 25 and November 29, 1951.

Grafton to Cairo and Elsewhere in Southern Illinois

Chautauqua.—A small village resort at the convergence of several ravines about 3 miles east of Grafton furnished the name for this prairie. The prairie, a part of section 13, T. 6 N., R. 12 W., in Jersey County, covered four south-facing spurs, mixed forest the coves. The base of each spur was a rock ledge at the top of the cliff which here closely parallels the Mississippi River. The spur slope above each ledge was covered with prairie; *Andropogon scoparius* was the dominant grass. *Melica nitens* occurred on the stony prairie slope above the ledge. Numerous weedy species such as *Setaria viridis*, *Achillea millefolium*, *Ambrosia elatior*, *Lappula echinata*, and *Geranium carolinianum* were present. Chautauqua hill prairie was visited July 8 and August 29, 1950; also May 25, 1951.

Principia.—A college furnished the name for this hill prairie, a part of the college campus. At this location in section 20, T. 6 N., R. 11 W., east of Elsah, Jersey County, the bluff of the Mississippi River has a high limestone cliff that is capped by a mantle of loess. The cliff is not a simple wall, but has sharp salients projecting well beyond the loess spurs above them, fig. 19. Prairie, with an area of 4 acres, predominated on the spurs in 1950 and 1951. *Andropogon scoparius* was the dominant grass; *Sporobolus asper* was locally abundant. Several paths used by students traversed the spurs and the crest of the ridge; elsewhere the prairie was undisturbed. The lower parts of coves supported mixed forest. Above this forest, tree seedlings and *Rhus glabra* occurred scatteringly to the top of the ridge, fig. 20. The north side of the ridge was well forested. Principia prairie was visited April 21, May 23, July 8, and August 29, 1950; July 5 and November 29, 1951.



Fig. 19.—Part of the cliff at Principia, near Elsah, Jersey County, with sharp rock salients that project beyond the spur fronts above.



Fig. 20.—An upper slope of a cove of Principia hill prairie with a mixture of prairie plants, *Rhus glabra*, and small oaks.

Oblate Fathers.—This name, taken from the mailbox at the entrance to the property on which the prairie is located, was adopted to designate a much-disturbed hill prairie situated in the northeast quarter of section 5, T. 5 N., R. 10 W., between Alton and Clifton Terrace, Madi-

son ridge between Illinois highway 157 and the Collinsville road just north of Caseyville in St. Clair County was the site of this hill prairie. The name of this prairie was derived from the presence of abandoned concrete bunkers along the highway. The site was visited July 8 and



Fig. 21.—Block House hill prairie, near Glen Carbon, Madison County. In the foreground is a cultivated field, beyond which are prairie spurs.

son County. When this site was visited on July 25, 1951, prairie with many weeds covered about 3 acres of the southwest-facing bluff slope that served as a pasture for horses.

Block House.—Responsible for the name of this hill prairie was the shape of a small house on the bluff-top in the northeast quarter of section 32, T. 4 N., R. 8 W., west and north of Glen Carbon, Madison County, fig. 21. Block House was visited July 8 and August 29, 1950; also May 24, 1951. Here the bluff was seen to be deep loess, with no visible rock outcrops. The lower slope of the bluff bordering the highway was a cultivated field; the upper slope had prairie-covered spurs and thicket-covered coves. *Andropogon scoparius* was the dominant grass. The top of the bluff was a disturbed prairie.

Bunker.—A group of loess mounds in section 5, T. 2 N., R. 8 W., that form a

August 29, 1950; also May 24, 1951. The east-facing slope of the ridge supported a mixed forest. On the west-facing slope of the ridge were prairie spurs, much disturbed by mules and cattle that grazed this land. The steep spur-fronts were prairie, the coves more or less wooded. One small cove contained much prairie vegetation, including *Silphium integrifolium*, *Vernonia missurica*, and *Cacalia atriplicifolia*. A thicket covered the base of the slope.

Edgemont.—This hill prairie, located in the southeast quarter of section 26, T. 2 N., R. 9 W., in Edgemont, a subdivision of East St. Louis, in 1940 occupied 4 acres of the bluff slope as determined by planimeter from aerial photographs. *Andropogon scoparius*, *A. gerardi*, and *Bouteloua curtipendula* were some of the prairie grasses on this slope when the prairie was visited on September 2, 1949. This prairie, because of its location, is rapidly



Fig. 22.—Valmeyer hill prairie, 3 miles south of Valmeyer, Monroe County.

being destroyed and replaced by homes and lawns.

Southwest Edgemont.—A very small hill prairie occupied a part of the bluff in section 4, T. 1 N., R. 9 W., southwest of Edgemont, when this area was visited September 2, 1949. *Andropogon scoparius*

was found with other prairie plants on this bluff.

Sugar Loaf.—This name is on the Cahokia sheet of the topographic map for that part of the bluff 1 mile south of Dupu, St. Clair County, that was visited July 9, 1950. Prairie, with *Bouteloua*



Fig. 23.—Part of the eroded cliff at Valmeyer hill prairie; prairie visible at upper right.

curtipendula locally abundant, covered both the rocky lower slope and the loess which capped the bluff. The loess had been badly disturbed by earth-moving operations to provide level homesites.

Valmeyer.—When visited, this hill prairie occupied the southwest-facing

was visited. An open mixture of trees and shrubs, with much *Juniperus virginiana*, surrounded the prairie openings, fig. 24. South along the bluffs large spurs were completely covered by prairie. The entire loess slope, with no visible rock outcrops, served as pastureland. This site was vis-



Fig. 24.—Prairie openings at Chalfin Bridge, Monroe County. Prairie is visible on the parallel ridges between rows of red cedars which grow in the coves.

slope of the ridge north of Monroe City Hollow about 3 miles south of Valmeyer, Monroe County, fig. 22. The site was visited September 2, 1949; April 22, May 24, July 9, and August 30, 1950. Prairie covered almost 9 acres of the upper slope between the cliff and the crest of the bluff. Above the eroded cliff, fig. 23, the slope was stony; the upper part was loess. The east-facing slope at the highest part of the ridge supported a mixed forest; farther south along the ridge, prairie covered the upper east-facing slope and a mixed forest occupied the basal part of the slope; at the southernmost part of the ridge only mixed forest occurred. In some places the rock outcrops were merely small vertical drops separated by steep rocky slopes on which much *Juniperus virginiana* grew. In the prairie above the rocky slopes, *Andropogon scoparius* was the dominant grass; *Psoralea tenuiflora* was common.

Chalfin Bridge.—Prairie openings occupied the bluffs southeast of Chalfin Bridge, Monroe County, when this area

ited August 30, 1950, and visited and photographed February 6, 1952.

Fults.—This hill prairie located on the bluff south of Fults Creek, southeast of the village of Fults in Monroe County, was visited September 11, 1948; June 16 and August 30, 1950; also May 24, 1951. It occupied about 12 acres, extended 0.6 mile along the upper southwest-facing slope of the bluff-ridge, fig. 25. On the northwest part of the bluff-ridge, long prairie spurs descended from the bluff-top to a small rock outcrop with a vertical face 2 to 3 feet high, below which was a forest-covered rocky slope that formed the lower third of the bluff. The coves between the long prairie spurs supported a mixed woodland. On the southeast part there was a high limestone cliff, and above it prairie covered both spurs and coves, which were there very poorly defined. *Galium virgatum* and *Heliotropium tenellum*, rare in Illinois, grew on the limestone ledge.

Renault.—Located about 2 miles south of Renault, Monroe County, this prairie

when last visited extended about 0.7 mile along the bluff-ridge and occupied almost 14 acres, of which 5 were studied. There was very little level area just above the rock ledge; the steep loess slope abruptly ended at the cliff. *Andropogon*

occupied the coves. *Juniperus virginiana*, *Quercus muhlenbergii*, and *Carya texana* grew on the narrow bluff-top ridge. The east-facing slope of the ridge was a fairly productive pasture, presumably once wooded. The prairie spurs were grazed,



Fig. 25.—Fults hill prairie, southeast of Fults, Monroe County.

scoparius was the dominant grass. Renault was visited July 30, 1950, and May 24, 1951.

Phegley.—The appellation for this prairie came from the name of the former tenant and caretaker, W. H. Phegley. In 1950 and 1951, the prairie occupied 6.33 acres of the southwest-facing slope of the bluff-ridge above the Columbia (Solvay) Quarry, 1.1 miles north of Prairie du Rocher, Randolph County.

The lower part of the brow slope above the limestone ledge at the top of the 200-foot cliff, fig. 26, was covered with fragments of limestone. Prairie occupied this almost level stony surface, which measured about 10 to 15 feet in width. Loess covered the bluff above this surface. This mantle of loess was dissected to form a series of spurs and coves, fig. 27. The spur fronts were steep, the upper slopes gently sloping upward from the fronts to the top of the bluff.

Prairie, with *Andropogon scoparius* as the dominant grass, covered the spurs; prairie, forest, or a mixture of both oc-

cupied the coves. *Juniperus virginiana*, *Quercus muhlenbergii*, and *Carya texana* grew on the narrow bluff-top ridge. The east-facing slope of the ridge was a fairly productive pasture, presumably once wooded. The prairie spurs were grazed,

though apparently less closely than the main part of the pasture. The principal results of grazing on the prairie spurs were the thinning of the native cover and the introduction of a few weeds.

Plots were staked on this and the adjacent prairie toward the northwest to furnish data for vegetation studies of this report.

Phegley hill prairie was visited June 15, July 29, and September 19, 1950; May 23, September 18, October 9–10, and October 16–18, 1951.

Sampson.—The name applied to this prairie was that of the farmer on whose land the prairie occurred. Sampson hill prairie, 4.5 acres in area, was actually a continuation of the Phegley hill prairie, from which it was separated by two parallel wire fences, 3 feet apart, an effective barrier against grazing cattle. The Phegley prairie served as a pasture; the Sampson prairie was not grazed. Located to the north of Columbia Quarry, the Sampson prairie was similar in most features to the Phegley prairie. However,



Fig. 26.—The cliff at the Columbia (Solvay) Quarry, north of Prairie du Rocher. The Phegley hill prairie occupies the slopes above this cliff. The spurs and coves shown in fig. 27 are located above the cliff near the right edge of the picture. Sampson prairie is to the north (left) of Phegley prairie.



Fig. 27.—A part of the Phegley hill prairie north of Prairie du Rocher. A small cove is visible in extreme lower left corner, a larger one near center of picture between two large spurs, which are plainly visible.

the bluff-top ridge and the east-facing slope of this ridge were forested, except for some cleared areas serving as fields for cultivated crops. This prairie was visited on the same dates as Phegley.

Stotz.—This hill prairie took its name from a quarry about a half mile north of Prairie du Rocher. Eight spurs of a bluff-ridge comprised the prairie, which covered about 6 acres in 1950; intervening ravines were wooded. The southernmost spur had been much trampled by humans, the others pastured. Native plants and weeds occurred on the pastured spurs in nearly equal proportions; the native plants persisted better on the nonpastured spur than on the others. *Andropogon scoparius* was the dominant grass of the prairie slopes. Patches of *Bonteloua curtipendula* grew throughout the prairie. The orchid *Hexalectris spicata* was found in the woodland border at the base of one spur. Stotz prairie was visited May 24 and July 30, 1950.

Allen Lake.—A small, crescent-shaped lake located near a loess-capped bluff-top supplied the name for this prairie, which was visited July 29, 1950. The prairie was west of the lake and 1.2 miles south of Prairie du Rocher. Prairie occupied 4.5 acres of the upper slope of the bluff. Limestone fragments covered the lower part of the slope. The dominant grass was *Andropogon scoparius*.

South Prairie du Rocher.—When visited June 16, 1950, this very small, pastured hill prairie occupied a part of the bluff 1.6 miles south of Prairie du Rocher. *Andropogon scoparius* was the dominant grass. *Cacalia tuberosa* was found growing in the loess.

Grand Canyon.—In 1949, this small prairie opening in section 2, T. 10 S., R. 3 W., 8 miles southwest of Murphysboro, Jackson County, occupied a west-facing slope at the north end of the bluff called Chalk Bluff, just south of the mouth of the valley known as Grand Canyon. *Andropogon scoparius* was the dominant grass. Small trees of hickory, sassafras, and white oak were scattered throughout. Grand Canyon prairie was visited October 28, 1949.

Fountain Bluff.—This hill prairie, observed in 1950 and 1951, took its name

from the isolated upland known as Fountain Bluff, which has a dissected loess top and for the greatest part vertical sandstone walls and is situated between the Mississippi River and the broad bottoms of the Big Muddy River west of the main chain of bluffs in western Jackson County. This isolated upland extends 4 miles north and south, and is 1.8 miles across at the widest part. Prairie-covered slopes were observed in section 36, T. 9 S., R. 4 W., at the northern end of Fountain Bluff, a distance of about 1 mile west and a little south of Gorham.

The northern and northwestern side of Fountain Bluff is an almost vertical sandstone wall into which a sizable ravine has cut southeast and then eastward so that part of the ravine is almost parallel to the steep northwest wall. A sizable ridge lies between the ravine and the Mississippi River bottomland on the north. On this ridge were the prairie-covered slopes, described in detail below.

Above the vertical rock cliff which forms the northeast wall of the ravine are four rock-strewn spurs, which at the time of this study were covered with prairie plants; *Andropogon scoparius* was the dominant grass. These prairie-covered spurs were separated by three narrow belts of woodland in shallow drainage-ways. The three narrow belts of woodland were joined upslope to form another and larger belt of woodland, at right angles to the three; the larger belt covered a rock-strewn slope.

Upslope from the rock-strewn slope, the bluff is capped by loess. Three spurs on this highest exposure of the ridge were occupied by prairie, the intervening coves by small trees and shrubs. One spur faced almost westward, overlooking the Mississippi bottomland, the others southwestward. The westward-facing spur was separated from the others by a narrow belt of timber. At the ridge-top, the prairie areas of the two southwest-facing spurs were connected to form a U-shaped hill prairie with the prongs of the U extending downslope.

When visited June 14, August 17, and September 19, 1950, and April 19 and May 23, 1951, prairie occupied about 3 acres of these spurs.

Government Rock.—Located in the southeast quarter of section 9, T. 11 S., R. 3 W., 4.5 miles north of the village of Wolf Lake, Union County, this hill prairie, when visited, occupied one of the sizable spurs which extends from the summit downslope to the rock cliff in that portion of the Mississippi bluffs known as Pine Hills. The appellation here used—Government Rock—is the one applied to this spur on the Wolf Lake sheet of the topographic map.

Above the cliff at the base of the spur is a steep west- and southwest-facing slope strewn with chert stones. When last seen, the lower part of the slope was occupied by a thin stand of undersized trees. Above this was prairie, dominated by *Andropogon scoparius* and *Bouteloua curtipendula*. A few small trees of *Quercus muhlenbergii*, *Ostrya virginiana*, *Juniperus virginiana*, and *Virburnum rufidulum* occurred in several open groups within the prairie.

Upslope on the spur was a strip, about 20 feet wide, with fewer prairie plants and an abundance of *Tephrosia virginiana*. This strip was followed by a zone of mixed upland forest, which included *Quercus muhlenbergii*, *Q. stellata*, *Sassafras albidum*, *Juglans nigra*, *Carya* spp., *Cercis canadensis*, and some large trees as well as seedlings of *Pinus echinata*. *Vaccinium arboreum* and *Ceanothus americanus* were common shrubs.

The uppermost part of the spur, which was capped by loess, was occupied by prairie vegetation. The narrow ridge-top had been much disturbed by picnickers. The east-facing slope of the bluff-ridge was forested nearly to the ridge-top.

Government Rock was visited October 27, 1949; August 17 and October 16, 1950; April 19 and May 23, 1951.

Tamms.—This hill-top prairie opening, about a half acre in area and located on the crest of a cherty ridge in the southeast quarter of section 35, T. 14 S., R. 2 W., 1 mile west and 1 mile north of Tamms, Alexander County, was visited September 20, 1950. The prairie area, containing such plants as *Andropogon gerardi*, *Solidago nemoralis*, and *Helianthus divaricatus*, was surrounded by a woodland of xeric oaks, hickory, and some

sassafras. One of the oaks on this ridge was *Quercus montana*.

Cave Creek.—When this area was last visited, a rock (limestone) hill prairie occupied part of the bluff on the east side of the confluence plain of Dutchman and Cave creeks, somewhat over a mile east of the Cache River, in the northeast quarter of section 28, T. 13 S., R. 3 E., about 5 miles south of Vienna and 1.5 miles northeast of Forman, Johnson County. The base of the bluff was wooded, but it had been much disturbed during the construction of a power line. The prairie opening above the disturbed wooded bluff base occupied about 1.5 acres of the south- and southwest-facing slope of the ridge. The prairie slope was strewn with rock fragments which had eroded from outcrops at various levels on the slope. In some places the slope was almost a rock pavement. Grasses and composites were the predominant vegetation; a few small trees of *Quercus muhlenbergii*, *Juniperus virginiana*, *Cornus florida*, and *Crataegus* spp. were found scattered throughout. The trees did not reach full size; after they had attained heights of 10 to 15 feet the tops lost vigor and the trees died.

Upslope from the prairie, the broadly rounded ridge was forested, but it had openings occupied chiefly by *Andropogon gerardi*. An interrupted limestone ledge traversed this forested surface. Much *Nothoscordum bivalve* grew in the crevices of this ledge.

Cave Creek prairie was visited June 10, August 17, and September 20, 1950; April 18 and May 22, 1951.

FLORA OF THE HILL PRAIRIES

As a means of determining what species of plants occur in Illinois hill prairies, numerous collections were made from early September, 1949, to the middle of October, 1951. Many of the plant species very common in Illinois were collected from only one prairie but their occurrence in other prairies was recorded in the field notes. Species less common were collected from each prairie site in which they were growing. More than

3,000 specimens were collected from the prairie areas; numerous others from the adjacent rock ledges, upland woods, wooded coves, and basal slopes of the bluffs. These specimens now form a part of the collections in the herbarium of the Illinois Natural History Survey at Urbana.

Collections and identification of hill prairie plants added several species to the known Illinois flora. *Rudbeckia missouriensis* was one of the rare plants reported (Evers 1951). The collections verified the present-day existence of certain species reported over a half century ago from Illinois but not collected in the state again until the field work for this study was undertaken. *Mentzelia oligosperma* is a notable example. The collections also increased the knowledge of the distribution of plants having somewhat restricted ranges in Illinois. Thus, it is now known that *Bouteloua curtipendula* ranges almost continuously, in suitable habitats, from northern to southern Illinois along the western border, that *Psoralea tenuiflora* ranges southward into Monroe County, and that *Houstonia nigricans* is quite common on loess slopes in southwestern Illinois.

The hill prairies contain prairie, woodland, cultivated, and introduced species. The woodland species are occasionally found in prairie just as the prairie species are found in woodland, especially in adjoining border areas. The cultivated plants usually are escapes that have become established in the hill prairies. Some, *Lespedeza stipulacea* for example, had been planted in certain prairies or in adjoining pastures by the landowners. Asia and Europe are the original homes of 30 of the species found, North America of the remainder.

Annotated List of Species

This list was compiled from collections made and notes taken on the Illinois hill prairies visited. Field notes were used to supplement the distribution record but no species is included in this list unless it was collected from at least one prairie. The list is not intended as a complete flora of the Illinois hill prairies. Such a

compilation would require much additional time and many additional visits to these sites. In some cases, only the generic name of a plant is given. Thus, the four species of grapes are included in this list under the term *Vitis* spp. In most instances, both generic and specific epithets are used. Any pertinent synonym is placed within brackets following the scientific name. Brief notes on the occurrence of each plant or plant group follow its name. The name of each plant that is of foreign origin is preceded by an asterisk (*).

Table 14, which summarizes presence, as discussed on page 392, contains a partial enumeration of the annotated list of species. Species found only on rock ledges, in coves, or in woodland borders near, but not in, the prairie stands of any site listed in table 14 are not indicated for that site. Some species mentioned in the annotated list are not included in table 14 because they are not native to North America or are not regarded as characteristic prairie species.

LECIDEACEAE

Lecidea spp. Lichens of this genus were found in 14 hill prairies. Two samples were identified by Dr. C. W. Dodge of the Missouri Botanical Garden as *L. decipiens* and *L. demissa*. These plants grew between grass tufts under the shade of the grass foliage on either loess or fine rock fragments.

MARCHANTIACEAE

Reboulia hemisphaerica (L.) Raddi. This was a frequently encountered liverwort on loess and rocks of hill prairies, where it grew in interspaces between bunches of grass.

MUSCI

An unidentified moss (or mosses) grew on loess of some hill prairies. All plants examined lacked sporophytes and accordingly remain unidentified.

SELAGINELLACEAE

Selaginella rupestris (L.) Spring. The rock selaginella grew in the sandy hill prairie at Devil's Backbone. Although found on sandstone outcrops in southern

Illinois (Pope County), apparently it is absent from similar situations in the Fountain Bluff hill prairie.

EQUISETACEAE

Equisetum hyemale L. The tall scouring-rush was seen in three hill prairies, Rock Island 31, Bunker, and Southwest Edgemont, where it occurred in loess. It was not seen on rocky slopes.

Equisetum laevigatum A. Br. [*E. kansanum* Schaffn.] The smooth scouring-rush was observed in seven bluff prairies, all of them in northern or central Illinois.

POLYPODIACEAE

Cheilanthes lanosa (Michx.) D. C. Eaton. The woolly lip-fern was found in rock prairie at Cave Creek. It was more abundant, however, on rock outcrops than on prairie slopes.

Pellaea atropurpurea (L.) Link. Although the usual habitat for purple cliff-brake is calcareous rocks, it occurred on the loose stony slopes at Cave Creek and Government Rock.

PINACEAE

Juniperus virginiana L. Red cedar was found in both rock and loess hill prairies and was common on rock ledges at the bases of prairie slopes and in wooded coves. It was the only tree species on some of the prairie slopes. Steyermark (1940) noted its frequent occurrence in Missouri glades.

GRAMINEAE

Agrostis hiemalis (Walt.) B.S.P. Ticklegrass was encountered only in rock prairie at Fountain Bluff.

Andropogon gerardi Vitman. [*A. furcatus* Muhl.] The big bluestem is an abundant prairie grass in Illinois. It was observed in 37 hill prairies. It was found as a dominant only in scattered patches, and in this status in only a few hill prairies.

Andropogon scoparius Michx. Little bluestem was found to be the usual dominant and is the most important grass of the hill prairies of Illinois.

Andropogon virginicus L. Broomsedge, a common grass in open woods, old fields,

and along roadsides in southern Illinois, was not found to be an important species of the hill prairies, having been seen in but one, Fountain Bluff, on the loess prairie slopes.

Aristida basiramea Engelm. ex Vasey. This plant was collected in only the Sunset Trail hill prairie.

Aristida intermedia Scribn. & Ball. This was observed only at Hill-Top and in the sandy prairie at Devil's Backbone.

Aristida longespica Poir. This three-awned grass was collected in prairie at Devil's Backbone and from a rock ledge at Cave Creek.

Aristida oligantha Michx. This weedy species was collected in only the Seehorn-Pavson hill prairie.

Bouteloua curtipendula (Michx.) Torr. Side-oats grama was found in 48 of the hill prairies examined. In southern Illinois, it was found in Cave Creek and Government Rock prairies, but it was not observed at Tamms, Fountain Bluff, or Grand Canyon. It was seen at most of the sites examined from Allen Lake northward along the Mississippi and Illinois rivers. Vestal (1945) mentioned "hill prairie and sandstone cliff-tops" as common habitats of this species in Illinois. He observed in July, 1941, that this *Bouteloua* dominated several steep southwest slopes of prairies along the lower Illinois in Jersey County, sites not included in this study. Side-oats grama was the dominant grass just above the rock ledge at Swarnes; a few feet higher on the prairie slope, *Andropogon scoparius* was dominant.

Bouteloua hirsuta Lag. Hairy grama was observed in eight hill prairies, most of them in northern Illinois. It grew in the heavily pastured loess prairie at Bald Bluff and also along the bluffs of the Illinois River at Mud Creek and Northeast Meredosia in central Illinois.

**Bromus commutatus* Schrad. Hairy chess was found in loess and rock prairie at five sites and in crevices of rock ledges at two others.

**Bromus tectorum* L. Downy chess or cheat was found in situations similar to those of hairy chess. It was more abundant in crevices of rock ledges than in hill prairie.

[illegible]

[illegible]

[illegible]

[illegible]

Danthonia spicata (L.) Beauv. ex Roem. & Schult. Poverty oat-grass was observed in rock prairie at Devil's Backbone. It is usually found in dry woodlands.

Elymus canadensis L. Canada wild-rye was found in 16 of the 61 hill prairies visited.

Elymus virginicus L. Virginia wild-rye was found in three hill prairies. It was more common in the adjacent woodlands than in prairie areas.

Eragrostis capillaris (L.) Nees. Lacegrass, a species of fields, clearings, rock ledges, and glades, was collected from hill prairie areas only on the rocky slope at Fountain Bluff.

**Eragrostis cilianensis* (All.) Lutati. Stinkgrass was found only on the disturbed crest of the bluff-ridge at Clendenny.

Eragrostis spectabilis (Pursh) Steud. Purple lovegrass was found scattered in 17 loess prairies.

Festuca octoflora Walt. Six-weeks fescue (including the variety *tenella*) was observed in six hill prairies, either on rocky or loess slopes. It was seen also on limestone ledges at three prairie sites.

Hordeum pusillum Nutt. Little barley was found only at Phegley hill prairie.

Koeleria cristata (L.) Pers. Junegrass occurred in scattered patches in 14 hill prairies, but it was never abundant.

Leptoloma cognatum (Schult.) Chase. Fall witchgrass, more frequent in sand prairie than in hill prairie, was observed at only two sites, Hidden Lake and Devil's Backbone.

Melica nitens (Scribn.) Nutt. ex Piper. Three-flower melic, a plant of rocky woods, bluffs, and glades, was found growing at Chautauqua on stony prairie slopes, at Valmeyer and Fuels on the rock ledges.

Muhlenbergia capillaris (Lam.) Trin. This muhly of rocky or sandy woodlands was found only in rock prairie at Government Rock.

Muhlenbergia cuspidata (Torr.) Rydb. Plains muhly, a plant of rocky bluffs, sandy woods, and loess hills, was found only in loess at Bluff Springs.

Muhlenbergia racemosa (Michx.) B.S.P. This species occurred on loess slopes at Wiersma, on rock-strewn slopes

of El Rancho, and on rock ledges at Fountain Bluff and Sampson.

Panicum capillare L. Witchgrass was observed in two hill prairies, Bluff Springs and Richwood.

Panicum dichotomum L. This panic grass was collected on the stony slopes at Fountain Bluff.

Panicum huachucae Ashe. [*P. lanuginosum* var. *fasciculatum* (Torr.) Fern.] This prairie species of panic grass was found in five hill prairies on the bluffs of the Mississippi River.

Panicum linearifolium Scribn. This species, usually of dry woods, was found on stony slopes of Fountain Bluff and Government Rock.

Panicum scribnerianum Nash. [*P. oligoanthos* var. *scribnerianum* (Nash) Fern.] This species was seen in 27 hill prairies, mostly on loess but occasionally on rocky slopes.

Panicum sphaerocarpon Ell. This panicum of sandy soil was collected at Phegley hill prairie in loess.

Panicum tennesseense Ashe. [*P. lanuginosum* var. *fasciculatum* (Torr.) Fern.] This plant grew in loess at Menominee Station and on stony slopes at Standard.

Panicum virgatum L. Switchgrass, common throughout most types of prairie in Illinois, was observed in hill prairie only at South Palisades and Hill-Top.

Paspalum stramineum Nash. This species was found in loess of five hill prairies.

**Poa compressa* L. Canada bluegrass occurred on two loess slopes and also two stony slopes.

Poa pratensis L. Kentucky bluegrass was found in more than 20 hill prairies. In some it was locally dominant but more often occurred scattered throughout the prairie area. It becomes dominant in pastures, and spreads from them.

**Setaria lutescens* (Weigel) Hubb. [*S. glauca* (L.) Beauv.] Yellow bristlegrass, or yellow foxtail, was found at Hidden Lake in loess and on the rock ledges at Valmeyer.

**Setaria viridis* (L.) Beauv. Green bristlegrass, or green foxtail, was seen on three prairie slopes. It was more common on rock ledges than in hill prairie.

Sorghastrum nutans (L.) Nash. Indian grass was observed in 23 hill prairies, usually in loess but occasionally on rocky slopes. It was the dominant grass in prairie at Hill-Top and also in the woodland border at North Pandarmie.

Sphenopholis obtusata (Michx.) Scribn. Prairie wedgegrass occurred in loess at Clendenny. It was seen in woodlands adjoining other prairies.

Sporobolus asper (Michx.) Kunth. This dropseed was observed in 10 hill prairies. It was frequent in loess at Principia.

Sporobolus cryptandrus (Torr.) A. Gray. Sand dropseed was seen in loess at Bielema, Seehorn-Payson, and Chautauqua prairies.

Sporobolus heterolepis (A. Gray) A. Gray. Prairie dropseed was not common in hill prairie. It was observed on stony slopes at El Rancho and Magnolia and on loess at Northeast Meredosia.

Sporobolus neglectus Nash. This annual dropseed grew on rocky slopes at Bielema and Clendenny hill prairies. At Clendenny it grew also on limestone ledges and in the border between prairie and wooded coves.

Sporobolus vaginiflorus (Torr.) Wood. This species occurred in loess at Bielema, Wiersma, and Swarnes, on rocky slopes and sandstone ledges at Fountain Bluff, and on limestone ledges at Phegley and Sampson.

Stipa spartea Trin. Porcupine grass, of infrequent occurrence in hill prairie, was observed at El Rancho, Balk, and Northeast Meredosia. It is commonly observed in flatland prairie.

Tridens flavus (L.) Hitchc. [*Triodia flava* (L.) Smyth.] Purpletop was found growing in loess at eight hill prairies in central and southern Illinois.

Uniola latifolia Michx. Broadleaf uniola, or spike grass, common in open woods in southern Illinois, was found in the disturbed loess prairie at Government Rock.

CYPERACEAE

Carex brevior (Dewey) Mack. A sedge of dry, rocky ground, this plant was collected from 10 hill prairies in northern and central Illinois.

Carex glaucoidea Tuckerm. [*C. flaccosperma* var. *glaucoidea* (Tuckerm.) Kükenth.] This sedge was collected from rock prairie at Fountain Bluff.

Carex gravida Bailey. This common sedge was observed only at Bluff Springs, on the loess slope.

Carex gravida var. *lunelliana* (Mack.) E. J. Hermann. This variety was collected only at Rock Creek, from loess.

Carex meadii Dewey. This sedge was collected on stony slopes at Cave Creek.

Carex muhlenbergii Schk. This sedge, common in sand prairie, was observed in only four hill prairies, Balk, Standard, Chautauqua, and Fountain Bluff.

Carex pennsylvanica Lam. A sedge of sterile soil and open woods, this species was collected at Devil's Backbone and Northeast Meredosia.

Cyperus filiculmis Vahl. The slender cyperus (including the variety *macilentus*), a plant of dry sandy soil, was seen in 16 hill prairies; its southernmost station was Fountain Bluff.

COMMELINACEAE

Tradescantia ohioensis Raf. [*T. canaliculata* Raf.] This spiderwort was seen in 16 hill prairies, growing on loess or stony slopes. Also, it was observed in crevices of limestone ledges at Stotz and South Prairie du Rocher.

Tradescantia virginiana L. This species, which occurs mostly in woods, thickets, and meadows, was found on the rocky slopes of Fountain Bluff and Government Rock.

JUNCACEAE

Juncus dudleyi Wieg. This rush was observed in loess prairie at Chautauqua and Fountain Bluff.

Juncus interior Wieg. This species was seen growing on loess slopes at Sunset Trail and on rocky slopes at Standard.

Juncus tenuis Willd. [*J. macer* S. F. Gray.] This common rush of woodlands was observed only at Oblate Fathers, in loess.

LILIACEAE

Allium canadense L. Wild garlic was seen in loess at Oblate Fathers and Allen Lake.

Allium stellatum Ker. This wild onion was found on rocky slopes at Government Rock and on loess slopes at Fufts, Sampson, and Phegley. Its occurrence on loess and stony slopes was nowhere so abundant as on rock ledges at the bases of these slopes.

**Allium vineale* L. Field garlic was found in two prairies, Sugar Loaf and Phegley.

**Asparagus officinalis* L. Asparagus was seen at Principia and Oblate Fathers prairies.

Camassia scilloides (Raf.) Cory. Locally abundant in some upland prairies of Illinois, wild hyacinth was found in hill prairie at Chautauqua.

Nothoscordum bivalve (L.) Britt. False garlic, one of the most frequent plants in thin soil of cliff-tops in the Shawnee Hills of southern Illinois, was observed on rocky slopes at Cave Creek and Government Rock.

Smilax bona-nox L. Fringed greenbrier, a dry-woodland species, occurred in prairie at Fountain Bluff and Cave Creek.

Smilax hispida Muhl. [*S. tamnoides* var. *hispida* (Muhl.) Fern.] Common greenbrier was found in Hidden Lake and Phegley prairies.

Smilax rotundifolia L. This woodland species was seen in Phegley, Government Rock, and Cave Creek prairies.

AMARYLLIDACEAE

Agave virginica L. American aloe was seen on stony slopes at Allen Lake and Cave Creek, and on loess slopes at Fufts, Sampson, and Phegley. It was observed also on rock ledges at South Prairie du Rocher and Stotz. The mature plants seem to flower every year. In thin soil on rock, the plants have short vertical stems and leaf-bases that vary in length with the depth of the soil. The fleshy roots radiate horizontally over the rock surface. In places, chiefly on rock ledges, the rosettes form fair-sized patches.

IRIDACEAE

**Belamcanda chinensis* (L.) DC. Blackberry-lily, an Asiatic species that is very common on open wooded slopes in Pike and Greene counties, where it forms dense stands on the basal slopes of

the bluffs, was found in loess at Walnut Creek and in the woodland border at Swarnes.

Sisyrinchium albidum Raf. This blue-eyed grass was found growing in loess in 11 hill prairies, most of them in southern Illinois.

Sisyrinchium campestre Bickn. This species occurred in 14 hill prairies in central and northern Illinois, from El Rancho south to Block House.

ORCHIDACEAE

Spiranthes cernua (L.) Rich. Nodding ladies'-tresses were seen at Clendenny, Reavis Spring, Bluff Springs, and Phegley, in each case in loess. They were fairly frequent at Reavis Spring.

SALICACEAE

Populus deltoides Marsh. A few individuals of eastern cottonwood were found in Ursa and Homan hill prairies.

Populus grandidentata Michx. The large-toothed aspen, usually found on wooded bluffs, occurred as small trees in Menominee Station, Hill-Top, and South Palisades hill prairies.

Populus tremuloides Michx. Quaking aspen was observed in the prairie at Menominee Station, North Savanna, and Balk. It and the large-toothed aspen were "in" but not "of" hill prairie.

Salix humilis Marsh. Prairie willow was collected from six hill prairies.

JUGLANDACEAE

Carya texana Buckl. Buckley's or black hickory (including varieties) is a tree of dry upland woods. Seedlings occasionally were found growing on the upper prairie slopes at Valmeyer, Sampson, and Phegley. Here it was found also at the bluff-top in the woodland border.

Juglans nigra L. Small individuals of black walnut were seen in North Savanna, Homan, Fall Creek, Walnut Creek, and North Eldred prairies. Large specimens were never found in prairie, only in the adjacent coves and bluff woods.

BETULACEAE

Corylus americana Walt. American hazel, a species of woods and thickets,

was seen in hill prairie at Sunset Trail and Ursa.

Ostrya virginiana (Mill.) K. Koch. American hop-hornbeam was found on four rocky prairie slopes and also on one loess slope. It was usually one of the trees found in wooded coves.

FAGACEAE

Quercus alba L. White oak saplings or small trees were observed in loess prairie at Sunset Trail, Hill-Top, and Fountain Bluff.

Quercus macrocarpa Michx. At Devil's Backbone and Ursa a few saplings of bur oak were found in the prairie. There and at other sites it was found also in the coves.

Quercus marilandica Muenchb. Black jack was represented by a few stunted individuals in the rock prairie at Government Rock.

Quercus muhlenbergii Engelm. Yellow or chinquapin oak occurred in 10 prairies. It was more abundant in clefts of limestone ledges, in coves, and on lower bluff slopes than in prairies.

Quercus stellata Wangh. Post oak occurred as scattered individuals in seven prairies. It was common in woodland borders in southwestern Illinois.

Quercus velutina Lam. Black oak, like other oaks a woodland species, was found in seven prairies, usually in the borders between prairie areas and upland woods, and occasionally as small solitary trees on the prairie slopes.

ULMACEAE

Celtis laevigata Willd. Sugarberry, a southern tree, most frequent in bottomlands, was represented by one specimen in rock prairie at Government Rock.

Ulmus alata Michx. Winged elm was found on the stony prairie slopes at Fountain Bluff, Government Rock, and Cave Creek.

Ulmus rubra Muhl. Very small individuals of slippery elm were found in eight hill prairies.

MORACEAE

Maclura pomifera (Raf.) Schneid. Osage orange was observed in the pastured loess prairie at Walnut Creek and

also in the prairie near woodland at Principia. In some other localities it was abundant in pastured woods on the basal slopes of bluffs.

CANNABINACEAE

**Cannabis sativa* L. Common hemp, abundant in some pastured sand areas of Illinois, was seen at South New Canton, a pastured hill prairie.

SANTALACEAE

Comandra umbellata (L.) Nutt. [*C. richardsiana* Fern.] Bastard-toadflax was found on 13 loess and 7 rocky prairie slopes from El Rancho and Devil's Backbone south to Renault.

POLYGONACEAE

Polygonum tenue Michx. Slender knotweed was collected from the rocky prairie slopes and the sandstone ledges at Fountain Bluff.

CHENOPODIACEAE

Chenopodium leptophyllum Nutt. [*C. pratericola* Rydb.] The narrow-leaved goosefoot was found in sandy loess at Balk and Rock Creek.

NYCTAGINACEAE

Mirabilis nyctaginea (Michx.) MacM. Umbrella-wort was found in only one hill prairie, Devil's Backbone.

CARYOPHYLLACEAE

Cerastium nutans Raf. Nodding mouse-ear chickweed occurred in Valmeyer and Fountain Bluff prairies.

**Cerastium vulgatum* L. Common mouse-ear chickweed was found in loess at Seehorn-Payson.

**Saponaria officinalis* L. Bouncing-bet was found in loess at Homan.

Silene antirrhina L. Sleepy catchfly was observed in nine rock or loess prairies and in crevices of rock ledges at the bases of four prairies.

RANUNCULACEAE

Anemone canadensis L. Meadow anemone was found in Bielema hill prairie.

Anemone cylindrica Gray. The long-fruited anemone occurred in 14 hill prairies, mostly in loess.

Anemone virginiana L. Tall anemone, or thimbleweed, was seen on three loess prairie slopes.

Aquilegia canadensis L. Wild columbine was found under a red cedar growing in loess at North Savanna. It was frequent on some rock ledges and in adjacent rocky woods.

Delphinium carolinianum var. *crispum* Perry. Blue larkspur was collected at Homan, Hidden Lake, and Sessions, where it was growing in loess.

Ranunculus fascicularis Muhl. Tufted or early buttercup was found in Balk and Devil's Backbone prairies.

LAURACEAE

Sassafras albidum (Nutt.) Nees. Sassafras occurred as small individuals on four prairie slopes.

FUMARIACEAE

Corydalis montana Engelm. [*C. aurea* var. *occidentalis* Engelm.] This corydalis of rocky woods, prairies, and glades (Palmer & Steyermark 1935) was found in the Valmeyer prairie.

CRUCIFERAE

Arabis lyrata L. This species of rock-cress occurred in loess at North Savanna and Balk, and on rock ledges at Menominee Station and Sunset Trail.

Draba reptans (Lam.) Fern. This small, inconspicuous species of whitlow-cress grew in interstices at eight hill prairie stations.

**Lepidium campestre* (L.) R. Br. Field peppergrass, or cow-cress, was seen in hill prairie only at Devil's Backbone.

**Lepidium densiflorum* Schrad. This introduced weed was seen in five of the hill prairies visited.

Lepidium virginicum L. Common peppergrass, a weedy crucifer, was found in three hill prairies. It was in places more abundant in crevices of rock ledges at the base of a prairie slope than in the prairie itself.

SAXIFRAGACEAE

Heuchera richardsonii R. Br. Alum-root was found in loess and on rocky slopes of 13 hill prairies from El Rancho to Cave Creek.

Ribes missouriense Nutt. This common gooseberry, usually of woods and thickets, occurred on the disturbed rocky slope of Bielema prairie.

ROSACEAE

Agrimonia rostellata Wallr. Agrimony was collected only at Chalfin Bridge near the woodland border of one of the prairie openings there. It is a plant that is usually found in woodlands.

Amelanchier arborea (Michx. f.) Fern. Serviceberry, usually of wooded hillsides, was observed on the rock-strewn slopes at Government Rock and Fountain Bluff. It was seen in crevices and clefts in rock ledges near other hill prairies.

Crataegus crus-galli L. Cockspur-thorn was found on stony slopes at Cave Creek and in loess at Mud Creek and Pere Marquette. In these localities and in others it was found also in the woodland borders.

Crataegus engelmanni Sarg. This hawthorn grew on the rock slopes at Cave Creek.

Crataegus mollis (T. & G.) Scheele. Red haw, usually a small tree of thickets and woodland borders, occurred in Cave Creek prairie.

Fragaria virginiana Duch. Strawberry was collected in loess at Bluff Springs, Mud Creek, and Northeast Meredosia.

Malus ioensis (Wood) Britt. [*Pyrus ioensis* (Wood) Bailey.] Wild crab, or Iowa crabapple, was found as seedlings in six hill prairies. In the coves it was more frequent and the plants were larger than in the prairie areas.

Potentilla arguta Pursh. The tall cinquefoil grew on stony or loess slopes of nine hill prairies in northern Illinois.

Potentilla simplex Michx. Common or old-field cinquefoil was found only at Sunset Trail, in loess.

Prunus lanata (Sudw.) Mack. & Bush. [*P. americana* var. *lanata* Sudw.] This wild plum was found in rock prairie at Cave Creek. At other sites, if present, it occurred in the woodland border.

Rosa carolina L. The pasture rose was found in rock prairie or in loess prairie at 12 sites. It was not common there. It is probably more common in flatland prairie.

Rosa setigera Michx. One plant of the climbing rose was observed at Phegley; it was not seen in other hill prairies. This rose is common in woodland borders.

Rosa suffulta Greene. [*R. arkansana* var. *suffulta* (Greene) Cockerell.] This rose was infrequent on loess slopes in four hill prairies.

Rubus flagellaris Willd. The dew-berry was found in one loess prairie, Phegley, near a thicket-covered cove.

Rubus frondosus Bigel. This black-berry was seen on the rocky slopes at Chautauqua prairie.

Rubus occidentalis L. Black raspberry was found in the rock prairie at Menominee Station.

LEGUMINOSAE

Amorpha canescens Pursh. Leadplant grew in scattered patches in 23 rock or loess prairies from El Rancho and Devil's Backbone south to Valmeyer.

Astragalus canadensis L. This milk-vetch occurred infrequently in loess at North Pandarmie, Principia, and Valmeyer. At Housen it was abundant in the woodland border at the crest of the ridge.

Astragalus distortus T. & G. This small milk-vetch was seen in loess, on rocky slopes, and in crevices of the rock ledge, at only one site, the Seehorn-Payson prairie.

Baptisia leucantha T. & G. Wild indigo, or prairie false-indigo, common in many of the upland prairies and in open woods of Illinois, was found in only one hill prairie, Hill-Top.

Cassia fasciculata Michx. Partridge-pea, common in hill prairies of southern Illinois, less frequent in those of northern Illinois and along the Illinois River, was found in 20 prairies.

Cassia nictitans L. This cassia was found in the cherty ridge-top prairie at Tamms, the stony and loess prairies at Fountain Bluff, and the loess prairie at Phegley.

Cercis canadensis L. Redbud, usually found on forested rocky slopes of bluffs, also was found in coves of hill prairies. Seedlings or very small trees were found occasionally on loess or rock prairie slopes.

Crotalaria sagittalis L. Rattlebox was observed in loess at Hill-Top, Clendenny, and Principia.

Desmanthus illinoensis (Michx.) MacM. Illinois- or prairie-mimosa, was found growing in loess of two hill prairies, Pere Marquette and Principia. In both sites it was locally abundant.

Desmodium canadense (L.) DC. This tick-clover was found only in the rock prairie at El Rancho.

Desmodium ciliare (Muhl.) DC. This species was collected at 12 stations from Clendenny south to Cave Creek. At Phegley and Sampson it grew also in the woodland.

Desmodium dillenii Darl.* This species was found in six hill prairies, Hidden Lake, Clendenny, Pere Marquette, Valmeyer, Fults, and Fountain Bluff.

Desmodium illinoense Gray. The Illinois tick-clover was collected in five hill prairies in central Illinois; all specimens collected were from loess slopes.

Desmodium paniculatum (L.) DC. This species, predominantly of open woods and thickets, was encountered in loess prairie at nine sites.

Desmodium sessilifolium (Torr.) T. & G. The sessile-leaved tick-clover was found at 22 sites, usually in loess prairie but occasionally on the rock-strewn slopes.

Galactia volubilis (L.) Britt. Milk-pea was collected from rock prairie at Cave Creek and Government Rock.

Gleditsia triacanthos L. Honey locust grew in scattered groups in four hill prairies.

Lespedeza capitata Michx. This bush-clover was a common plant on loess and occasionally on rocky prairie slopes. It was present in 27 of the 61 sites studied.

Lespedeza hirta (L.) Hornem. This lespedeza was collected from the cherty prairie at Tamms and was observed in the woodland border at Government Rock.

Lespedeza intermedia (S. Wats.) Britt. This species was found in loess at five prairie sites in southern Illinois.

Lespedeza procumbens Michx. Trail-ing hush-clover, a species of rocky woods,

*In the treatment of this genus in *Gray's Manual*, edition 8, this entity has been segregated into two species, *Desmodium perplexum* and *D. glabellum*.

was encountered in five prairies, where it grew also in the wooded coves.

Lespedeza repens (L.) Bart. A few plants of creeping bush-clover were found in Sampson and Ursa hill prairies.

X *Lespedeza simulata* Mack. & Bush. This species was collected from loess prairie at Renault and Fults, also on rocky prairie slopes of the latter.

**Lespedeza stipulacea* Maxim. Korean clover or lespedeza was seen in 13 hill prairies. At Rock Creek it had been planted; elsewhere it apparently was an escape from the nearby pasturelands.

Lespedeza violacea (L.) Pers. Although usually found only in thickets and rocky woods, this lespedeza was seen in five prairies. It was more common, however, in the nearby wooded coves than on the prairie slopes.

Lespedeza virginica (L.) Britt. Slen-der bush-clover, a plant of woods, thickets, prairies, and glades, was seen growing in 18 prairie sites, from Clendenny and Richwood south to Government Rock and Cave Creek.

**Medicago lupulina* L. Black medic, a European species, was observed in East Henry and Mud Creek prairies.

**Melilotus alba* Desr. White sweet clover was seen in 25 hill prairies. It appeared to have been planted at Clendenny. It formed a very dense stand at Hidden Lake.

**Melilotus officinalis* (L.) Lam. Yellow sweet clover was less frequent than white sweet clover; it was found at five prairie sites.

Petalostemum candidum (Willd.) Michx. White prairie-clover was collected or observed at 19 prairie sites from Government Rock northward. It occurred abundantly in loess prairie at Homan, but at Phegley it was restricted to rocky wooded coves.

Petalostemum purpureum (Vent.) Rydb. Purple prairie-clover occurred in 43 prairies from El Rancho and Devil's Backbone south to Government Rock.

Psoralea tenuiflora Pursh. The many-flowered psoralea occurred in 27 hill prairies from Valmeyer north to Ursa and Standard. In some sites it was the most conspicuous species in early summer. It is a distinctly western species and is very

infrequent in Illinois other than in hill prairie.

Robinia pseudo-acacia L. Black locust, not native in Illinois, has spread from numerous plantations and was seen in four loess prairies.

Strophostyles helvola (L.) Ell. This wild bean of sand, rocky woods, or thickets was observed infrequently in seven hill prairies.

Strophostyles leiosperma (T. & G.) Piper. This species was observed in two places, at Hill-Top and Rock Island 31.

Stylosanthes biflora (L.) B.S.P. Pencil-flower, a plant of rocky woods and also glades, was collected at Fountain Bluff on both rocky and loess prairie slopes and at Sampson in loess prairie near a cove.

Tephrosia virginiana (L.) Pers. Goat's-rue, very common in the sand areas of Illinois, and occasional in dry, open woods with varying soil textures, was collected in a rock prairie at Government Rock, where it was abundant also in the woodland border, and in loess prairie at Oblate Fathers, Valmeyer, and Renault.

LINACEAE

Linum sulcatum Riddell. This annual flax was observed in loess and occasionally in stony soil in 28 hill prairies from Bielema and Magnolia south to Allen Lake.

OXALIDACEAE

Oxalis stricta L. Upright yellow wood-sorrel grew on rocky and loess prairie slopes at nine sites. It was found in crevices of ledges at two additional places.

Oxalis violacea L. Violet wood-sorrel was found at 25 sites. In some places it blossomed in spring and again in early autumn.

GERANIACEAE

Geranium carolinianum L. This weedy cranesbill was seen in four hill prairies in southwestern Illinois.

RUTACEAE

Ptelea trifoliata L. Scattered small individuals of wafer-ash grew in 11 hill prairies. This plant was more abundant in coves or on basal slopes of the bluffs than in the prairies.

Xanthoxylum americanum Mill. Prickly ash was seen in Balk prairie, where it was growing in loess. The woodlands adjoining many other prairies contained this species; only at Balk had it strayed into the prairie.

POLYGALACEAE

Polygala incarnata L. This milkwort was found in loess on the crest of the ridge at Northeast Meredosia.

Polygala verticillata L. This species, easily overlooked in its location between tufts of grass, was observed in nine prairies from Fountain Bluff northward.

EUPHORBIACEAE

Acalypha gracilens Gray. This three-seeded mercury grew on the rocky prairie slopes and sandstone ledges at Fountain Bluff.

Chamaesyce glyptosperma (Engelm.) Small. [*Euphorbia glyptosperma* Engelm.] This plant was found in rock prairie at Devil's Backbone.

Chamaesyce maculata (L.) Small. [*Euphorbia maculata* L.] Nodding spurge was seen in 14 hill prairies; in none of them was it abundant.

Chamaesyce supina (Raf.) Moldenke. [*Euphorbia supina* Raf.] Milk-purslane was found between the bunches of grass in six hill prairies. It was observed also in crevices of ledges.

Croton capitatus Michx. Hogwort was found only at Principia and Edgemont.

Croton glandulosus var. *septentrionalis* Muell. Arg. Sand croton was found only at Bluff Springs and Block House.

Croton monanthogynus Michx. Prairie-tea, a frequently encountered plant in hill prairie, was observed at 19 sites in central and southern Illinois.

Euphorbia corollata L. Flowering spurge, a common plant in prairies, glades, and rocky ground, was found in 36 hill prairies, where it grew in loess and rocky soil. It was found also in some adjacent woodlands.

**Euphorbia cyparissias* L. Cypress-spurge, or cemetery cypress, was found in the Seehorn-Payson prairie as an escape from a nearby cemetery.

Euphorbia obtusata Pursh. This species was collected at Fuels.

Poinsettia dentata (Michx.) Small. [*Euphorbia dentata* Michx.] This weedy species was found in 15 hill prairies.

ANACARDIACEAE

Rhus aromatica Ait. Fragrant sumac was seen in 15 hill prairies, either in loess or rocky soil. It was encountered also in some wooded coves as well as in bluff-top woods.

Rhus aromatica var. *arenaria* (Greene) Fern. This variety of the fragrant sumac was found in sandy loess at Bald Bluff, Balk, Bielema, and South Palisades.

Rhus copallina L. Shining or dwarf sumac was found in loess at Southwest Edgemont, Chalfin Bridge, Fuels, and Phegley.

Rhus glabra L. Smooth sumac was a very frequent plant in the hill prairies studied. It was observed on 33 rock and loess prairie slopes. It grew in coves and extended out on the spurs, or it grew in the borders of the bluff-top woods and out in the prairies as isolated individuals. In some places it was very dense and formed a thicket. In a few other places most of the individuals in open groups were dead or dying, a result possibly of fire, or of competition by grasses, competition intensified by summer drought.

Rhus radicans L. Poison ivy, erroneously called poison oak, was very abundant in woodlands adjacent to most of the hill prairies. It was found at Principia in loess and rock prairie.

AQUIFOLIACEAE

Ilex decidua Walt. Possumhaw or swamp holly, normally found in bottom-land woods or on basal slopes of bluffs, infrequently on shaded cliffs, was observed in a cove at Phegley, 200 feet above the adjacent bottomland.

CELASTRACEAE

Celastrus scandens L. Bittersweet occurred in eight hill prairies that adjoined woods. It occurred also in wooded coves near prairie.

RHAMNACEAE

Ceanothus americanus L. New Jersey tea, a plant of rocky woods, forest borders, and glades, was observed in 12 loess

and in 2 rock prairies. It was found also in wooded coves nearby.

VITACEAE

Vitis spp. Stunted individuals of probably four species of grape were found in a number of hill prairies. No fruiting vines were found in these hill prairies.

HYPERICACEAE

**Hypericum perforatum* L. Common St. John's-wort was found in two loess prairies, Sunset Trail and Bluffs.

Hypericum punctatum Lam. Spotted St. John's-wort was observed in five hill prairies in central and southern Illinois.

Hypericum sphaerocarpum Michx. Round-fruited St. John's-wort was seen in five prairies.

CISTACEAE

Helianthemum bicknellii Fern. Frost-weed, a plant of sand prairie, rocky prairie, and glade, was found in sandy loess at Menominee Station and Sunset Trail.

Lechea leggettii Britt. & Hollick. This pinweed was observed in loess at Menominee Station.

Lechea stricta Leggett. It was seen in hill prairie only at Valmeyer.

Lechea villosa Ell. This species was encountered at Principia.

VIOLACEAE

Viola pedata L. Bird-foot violet was not found frequently. It grew on rocky slopes at Government Rock and in loess at Balk and Devil's Backbone.

Viola rafinesquii Greene. [*V. kitaibeliana* var. *rafinesquii* (Greene) Fern.] Field or wild pansy, a plant of prairies, roadsides, glades, and waste places, occurred in five hill prairies.

LOASACEAE

Mentzelia oligosperma Nutt. Stick-leaf, or few-seeded mentzelia, fig. 28, grew chiefly in crevices of rock ledges; it grew also on rocky slopes above the ledges. It was collected on ledges at North Pandarmie, Fults, and Phegley; on rock prairie, as well as ledges, at Seehorn-Payson, Sessions, South New Canton, Swarnes, and Valmeyer. It was not observed in the hill prairies between Swarnes and

Valmeyer, nor north along the bluffs east of the Bluff Hall railroad siding in Adams County. In Illinois it is apparently restricted to unglaciated bluffs or to those not glaciated since Kansan time. This genus is one of those of chiefly western distribution which reaches its eastern limit in exposed xeric habitats in western Illinois.

CACTACEAE

Opuntia rafinesquii Engelm. [*O. humifusa* Raf.] The prickly pear was observed at 10 sites from Seehorn-Payson south to Phegley. It was found on rock ledges at Seehorn-Payson, Valmeyer, and Stotz; on rocky and loess slopes at Sessions, Housen, Chautauqua, Principia, Fults, Sampson, and Phegley.

ONAGRACEAE

Gaura biennis L. Biennial gaura, a plant of prairies, roadsides, and waste places, was collected in Seehorn-Payson, Reavis Spring, Bluff Springs, Valmeyer, and Fults prairies.

Oenothera biennis L. Common evening primrose was seen infrequently in eight hill prairies.

Oenothera laciniata Hill. This evening primrose was found in 11 hill prairies in central and southern Illinois.

UMBELLIFERAE

Chaerophyllum sp. An unidentified species of this genus was found at Clendenny.

**Daucus carota* L. Wild carrot was collected only at Phegley, where but few plants were found.

Polytaenia nuttallii DC. Prairie-parsley was found growing in loess prairie and also at the border between prairie and rock ledges. It was collected at Reavis Spring, Chautauqua, Valmeyer, and Fults.

Spermolepis inermis (Nutt.) Math. & Const. This umbellifer was found in loess prairie and on rock ledges at Seehorn-Payson.

Taenidia integerrima (L.) Drude. Taenidia, or yellow pimperl, was found on rocky slopes at Cave Creek. It was restricted principally to slopes with sparse cover, or to comparatively bare



Fig. 28.—*Mentzelia oligosperma* growing in thin loess just above a limestone cliff, south of New Canton, Pike County.

spaces just above or just below slopes. Presumably it cannot compete with vigorous species.

**Torilis japonica* (Houtt.) DC. Hedge-parsley was found in hill prairie only at Chautauqua. This species seemingly is becoming widespread in Illinois.

Zizia aurea (L.) Koch. Golden alexanders, a plant of both prairie and forest, grew in the rock prairie at Cave Creek.

CORNACEAE

Cornus drummondii Meyer. This dogwood, common in thickets and in woodland borders, was observed growing singly

or in small thickets in loess prairie at 19 sites. It was common also in the adjoining coves.

Cornus florida L. Scattered individuals of flowering dogwood, a very attractive plant in springtime, were seen in Swarnes and Cave Creek prairies.

ERICACEAE

Vaccinium arboreum Marsh. Farkleberry, or tree huckleberry, a plant of rocky woods, was collected in rock prairie at Government Rock.

Vaccinium vacillans Torr. Hill or low blueberry, a species of rocky woods, bluffs,

and glades, grew on the sandstone ledges and in rock prairie at Fountain Bluff.

PRIMULACEAE

Androsace occidentalis Pursh. This species was encountered on the rock ledges at Valmeyer and in the rock prairie at Devil's Backbone.

Dodecatheon meadia L. This shooting star, occurring in both prairie and forest in Illinois, was found in loess prairie at Reavis Spring and in the border of prairie and rock ledge at Valmeyer.

EBENACEAE

Diospyros virginiana L. Persimmon occasionally was found growing as scattered individuals in the hill prairies of southern Illinois.

OLEACEAE

Fraxinus americana L. White ash, common in wooded coves, was found in a few hill prairies.

Fraxinus nigra Marsh. Black ash was observed in the border between the rock ledge and rock prairie at Principia. It was observed in no other prairie.

GENTIANACEAE

Gentiana quinquefolia L. Stiff gentian was collected in loess at Wiersma.

Sabatia angularis (L.) Pursh. Rose gentian, or rose-pink, was collected from rock prairie at Sessions.

APOCYNACEAE

Apocynum cannabinum L. Hemp dogbane, or Indian hemp, chiefly of open woods, glades, prairies, and roadsides, was collected at Principia and Fountain Bluff.

Apocynum sibiricum Jacq. This dogbane was found in two prairies, Seehorn-Payson and Ursa.

ASCLEPIADACEAE

Asclepias amplexicaulis Sm. This milkweed was collected from eight loess prairies.

Asclepias hirtella (Pennell) Woodson. [*Acerates hirtella* Pennell.] Although common in upland prairie in Illinois, it was collected in hill prairie only at Edgemont.

Asclepias quadrifolia Jacq. This woodland milkweed was seen in rock prairie at Government Rock.

Asclepias stenophylla Gray. [*Acerates angustifolia* (Nutt.) Dene.] This species of green milkweed was collected from eight hill prairies in Adams, Pike, and Calhoun counties. In Illinois, it is apparently restricted to hill prairies.

Asclepias tuberosa L. Butterfly-weed, common in some upland prairies in Illinois, was found in but one hill prairie, Government Rock. It is one of the most attractive prairie plants. It can be successfully transplanted to home gardens.

Asclepias verticillata L. Horsetail or whorled milkweed, poisonous to livestock, was found in 18 hill prairies, most of them in northern and central Illinois.

Asclepias viridiflora Raf. [*Acerates viridiflora* (Raf.) Eaton.] This green milkweed was common in hill prairies; it was observed in 20 of them.

POLEMONIACEAE

Phlox bifida Beck. Sand phlox was found in five rocky prairies in southern Illinois, and in five sandy loess prairies in the Illinois River valley.

Phlox pilosa L. Downy phlox was found in five hill prairies, on either rocky or loess slopes.

BORAGINACEAE

**Lappula echinata* Gilib. European stickseed was collected at Chautauqua in rock prairie.

Lithospermum canescens (Michx.) Lehm. This gromwell occurred on 2 rock and 14 loess prairie slopes.

Lithospermum croceum Fern. Although common in sand prairie in Illinois, this species was collected in only two hill prairies, Seehorn-Payson and North El-dred.

Lithospermum incisum Lehm. This narrow-leaved gromwell was very common in hill prairie from Bielema and Devil's Backbone south to Allen Lake. It was observed in 27 prairies.

Myosotis verna Nutt. This forget-me-not was found in the Fountain Bluff prairie.

Onosmodium occidentale Mack. False gromwell or marblesseed was seen in seven

hill prairies from El Rancho and Reavis Spring to Cave Creek.

VERBENACEAE

Verbena bracteata Lag. & Rodr. This vervain, abundant along roadsides, was observed in hill prairie only at Balk.

Verbena canadensis (L.) Britt. This attractive vervain, common on rocky bluffs in Monroe County, was collected at Fults and Renault in that county and at Government Rock in Union County.

Verbena simplex Lehm. The narrow-leaved vervain was found growing in seven hill prairies, in either rocky soil or loess.

Verbena stricta Vent. Hoary vervain was present in 42 hill prairies from El Rancho and Magnolia to Allen Lake.

LABIATAE

Blephilia ciliata (L.) Benth. Wood mint was collected on the rocky prairie slope at Devil's Backbone.

Cunila origanoides (L.) Britt. Stone mint was found in the rock prairie and on sandstone ledges at Fountain Bluff, and on a rock outcrop at Government Rock. It was more abundant in adjacent open woods than in prairie areas.

Hedeoma hispida Pursh. Rough pennyroyal was present in many hill prairies and adjoining rock ledges from Menominee Station and Devil's Backbone south to South Prairie du Rocher.

Hedeoma pulegioides (L.) Pers. American pennyroyal, common in woodlands, was found in rock prairie at Ursa and in loess prairie at Wiersma.

Isanthus brachiatus (L.) B.S.P. False pennyroyal grew in 10 rock and loess prairies and on 7 rock ledges from Fall Creek and Magnolia south to Cave Creek.

Monarda bradburiana Beck. [*M. russeiana* Nutt. (?)] This species of bergamot was observed in three rock and three loess prairies in southern Illinois. It was commonly found also in open woods and thickets near hill prairies.

Monarda fistulosa L. Wild bergamot, common in prairie vegetation along roadsides and railroads, was seen in 16 hill prairies.

Monarda punctata L. Spotted bergamot, locally abundant in sand prairies and

barrens of Illinois, was found in sandy loess at Walnut Creek.

**Nepeta cataria* L. Catnip was found in hill prairie at South New Canton and Chautauqua.

Physostegia virginiana (L.) Benth. [*P. angustifolia* Fern. (?)] False dragonhead was found in 16 hill prairies from Sessions and Reavis Spring south to Cave Creek. It was seen in loess and rock prairie and occasionally in crevices of rock ledges.

Prunella vulgaris L. Selfheal, a common plant of woods, fallow fields, and thickets, was observed growing in loess at Sunset Trail.

Pycnanthemum flexuosum (Walt.) B.S.P. This mint of open rocky woods, thickets, and fields was seen in loess at Oblate Fathers.

Pycnanthemum pilosum Nutt. This was the common mountain mint in 29 loess prairies from Sunset Trail and Reavis Spring south to Allen Lake.

Pycnanthemum virginianum (L.) Dur. & Jacks. This species was collected at El Rancho, Ursa, and Block House.

Salvia pitcheri Torr. [*S. azurea* var. *grandiflora* Benth.] Blue sage was collected from rock prairie at Cave Creek. This sage is a western species, with the eastern extent of its range from Minnesota to Kentucky coming through Illinois.

Scutellaria leonardi Epling. [*S. parvula* var. *leonardi* (Epling) Fern.] This small skullcap grew in 10 hill prairies, most of them in northern and central Illinois.

Scutellaria ovata Hill. This skullcap was found in loess prairie at Valmeyer.

Scutellaria parvula Michx. This small glandular-pubescent skullcap was seen in 10 rock and loess prairies and in crevices of 7 rock-ledge locations.

Teucrium canadense L. This wood-sage was found in small numbers in six loess prairies.

SOLANACEAE

Physalis heterophylla Nees. This ground-cherry was seen in seven hill prairies.

Physalis pubescens L. This pubescent annual ground-cherry was seen at Bluff Springs.

Physalis virginiana Mill. Virginia ground-cherry was collected from six loess prairies in central and northern Illinois.

Solanum carolinense L. Horse-nettle was seen only in pastured loess prairie at Walnut Creek.

SCROPHULARIACEAE

Aureolaria grandiflora (Benth.) Pennell. [*Gerardia grandiflora* Benth.] False foxglove, a species of woods, openings, and thickets, was observed in loess at Sunset Trail and Magnolia.

Buchnera americana L. Blue hearts, previously reported in Illinois only from Cook and Menard counties, was found in six hill prairies in Calhoun, Monroe, and Randolph counties.

Dasistoma macrophylla (Nutt.) Raf. [*Seymeria macrophylla* Nutt.] Mullein foxglove, commonly found in open woods and thickets, was found growing in loess at Swarnes hill prairie.

Gerardia aspera Dougl. This *gerardia* was seen in at least 17 hill prairies from northern to southern Illinois.

Gerardia gattingeri Small. This plant was seen in at least six hill prairies in south-central Illinois.

Gerardia skinneriana Wood. This plant of bluffs, sands, and barrens was found in four loess prairies.

Gerardia tenuifolia Vahl. This *gerardia* of wooded slopes was found in three hill prairies.

Pedicularis canadensis L. Wood-betony or common lousewort was found in loess prairie at North Eldred, where also it was very common in the wooded coves.

Penstemon pallidus Small. This pale penstemon was collected from 36 loess and rock prairie slopes and 14 rock ledges in 40 sites from Bielema and Devil's Backbone to Cave Creek. It was moderately abundant in many of these sites.

Scrophularia marilandica L. Usually found in thickets and woodland borders, this figwort was collected from loess prairie at Balk.

Synthyris bullii (Eaton) Heller. [*Wulfenia* Barnh.; *Besseyia* Eaton.] This plant of sandy soil was collected from hill prairie at Bielema and Devil's Backbone, both sites near the margin of the Wisconsin glaciation.

**Verbascum thapsus* L. Common mullein was observed in loess or rock prairie, or in crevices of rock ledges, in 17 hill prairies.

**Veronica arvensis* L. Corn-speedwell, a common European weed, was found infrequently in eight hill prairies.

Veronica peregrina L. Purslane-speedwell, another weedy species, was collected from rock prairie at Fountain Bluff.

Veronicastrum virginicum (L.) Farw. Culver's-root, a plant of woods, thickets, and prairies, was observed in seven hill prairies. In none of these was it so common as in flatland prairie.

BIGNONIACEAE

Bignonia capreolata L. Cross-vine, a southern species, was found as a stray at Cave Creek.

Campsis radicans (L.) Seem. Trumpet-creeper, common in woods, thickets, and fields in southern Illinois, was found in four hill prairies.

ACANTHACEAE

Ruellia humilis Nutt. Hairy ruellia was found in 30 hill prairies (also occasionally in crevices of rock ledges) from Bald Bluff and Devil's Backbone to Cave Creek.

PLANTAGINACEAE

Plantago aristata Michx. The bracted plantain, a common roadside and open-field weed in compact soils of southern Illinois, was collected from five hill prairies, in loess and in rocky soil.

Plantago purshii R. & S. This western species of plantain, locally abundant in some sand prairies of the state, was found in sandy loess at Bielema and Bluff Springs.

Plantago rugelii Dcne. This plantain was seen in loess prairie at Principia and Hill-Top. In both sites it grew in the disturbed portions.

Plantago virginica L. Hoary plantain, common in fields and rocky waste places, was found in 20 hill prairies.

RUBIACEAE

Diodia teres Walt. Rough buttonweed was collected from one loess prairie. Stotz.

Galium aparine L. Cleavers was found in nine hill prairies. It was nowhere very abundant in the prairies, but was common in the adjacent woodlands.

Galium circaezans Michx. Wild lico-rice, a plant of thickets and rocky woods, was found growing in three hill prairies. Also, it was seen in wooded coves.

Galium pilosum Ait. This bedstraw, a plant of thickets and rocky woods, was seen in three loess prairies and one rock prairie in southern Illinois. It was found in wooded coves also.

Houstonia lanceolata (Poir.) Britt. This species of bluets was found at Cave Creek and Block House.

Houstonia longifolia Gaertn. This species was encountered in rock prairie at Fountain Bluff and in loess prairie at Valmeyer.

Houstonia nigricans (Lam.) Fern. This narrow-leaved species of bluets was found growing abundantly in hill prairie from Swarnes to South Prairie du Rocher, except at Block House, South Edgemont, Sugar Loaf, and Chalfin Bridge. It was present also at North Eldred, Richwood, and Pere Marquette.

CAPRIFOLIACEAE

Symphoricarpos orbiculatus Moench. Buckbrush, a plant of thickets, pastures, and open woods, was seen in 16 loess hill prairies. It was frequent in the coves; in places it formed open pure stands and was the only shrubby species present.

Triostemon perfoliatum L. Horse-gen-tian, or wild coffee, a species of open woods and thickets, was observed in loess prairie at Fall Creek, Reavis Spring, Walnut Creek, and Block House.

Viburnum rufidulum Raf. Southern blackhaw, a small tree or shrub of rocky woods, thickets, and glades, was found in rock prairie at Government Rock and Fountain Bluff. It was found in coves at Phegley and on the rock ledges at Renault, Chautauqua, and Clendenny.

CAMPANULACEAE

Campanula rotundifolia L. [*C. intercedens* Witasek.] This bellflower was collected from rock prairie at Bielema. It was also seen on the cliffs at Balk and on sandstone at Fountain Bluff.

Specularia perfoliata (L.) A. DC. Venus's looking-glass, a plant of fallow fields, prairies, and waste places, was found growing in eight hill prairies.

LOBELIACEAE

Lobelia spicata Lam. Spiked or pale-spike lobelia was observed in 11 loess hill prairies.

Lobelia spicata var. *leptostachys* (A. DC.) Mack. & Bush. [*L. leptostachys* A. DC.] This variety was found in six loess hill prairies, in two of these prairies with the typical form of the species.

COMPOSITAE

**Achillea millefolium* L. Yarrow, common in pastures, waste places, along roadsides, and similar places, was found infrequently in five hill prairies.

Agoseris cuspidata (Pursh) Raf. This plant was found in loess prairie at Reavis Spring.

Ambrosia coronopifolia T. & G. [*A. psilostachya* var. *coronopifolia* (T. & G.) Farw.] Western ragweed was found in central Illinois hill prairies at Sessions, Reavis Spring, Northeast Meredosia, Bluffs, Walnut Creek, and North Eldred. It is abundant in the sand prairies of Illinois.

Ambrosia elatior L. [*A. artemisiifolia* var. *elatior* (L.) Descourtills.] The common ragweed was found in 12 loess hill prairies.

Ambrosia trifida L. Giant ragweed was found in hill prairie only at Chautauqua. It was observed in a disturbed part of the rock prairie and was only about 2 feet tall.

Antennaria neglecta Greene. This small pussytoes was found between the bunches of grass at Menominee Station, Reavis Spring, Northeast Meredosia, Bluffs, Walnut Creek, and North Eldred.

Antennaria plantaginifolia (L.) Hook. This species was seen in seven hill prairies. It was more abundant in the adjacent rocky open woods than in the prairie areas.

Artemisia caudata Michx. This worm-wood, frequently encountered in sand prairies, was observed in rocky and sandy loess hill prairies at seven sites in northern and central Illinois.

Aster anomalus Engelm. This aster, a plant of rocky wooded bluffs, was found in hill prairie at Sessions and Fountain Bluff.

Aster azureus Lindl. The bright blue aster was found in 16 hill prairies from Menominee Station and Reavis Spring south to Chalfin Bridge.

Aster ericoides L. (including *A. exiguus* Rydb.). This weedy aster was seen in 18 hill prairies.

Aster linariifolius L. Abundant in sand prairie, this aster was collected from loess prairie at Northeast Meredosia and Bunker.

Aster oblongifolius Nutt. The oblong-leaf aster, frequently seen on rocky bluffs, was collected from 36 sites in loess and rock prairies; also it was observed in crevices of rock ledges, in recesses on small cliffs, and on rocky wooded slopes. It ranged from El Rancho and Devil's Backbone south to Cave Creek.

Aster parviceps (Burgess) Mack. & Bush. An aster, possibly this species, was collected from rock prairie at Chautauqua and from loess prairie at Fall Creek, Seehorn-Payson, and Sessions.

Aster patens Ait. The spreading aster was seen in 13 hill prairies from Clendenny to Cave Creek.

Aster pilosus Willd. Heath aster, a weedy species, was present in 16 hill prairies. It was not so common there as in flatland prairies.

Aster ptarmicoides (Nees) T. & G. White upland aster was found at Wiersma and Rock Island 31 prairies.

Aster sagittifolius Wedem. The arrow aster, usually found in open woods, occurred in the rocky prairie at Government Rock and in loess prairie at Clendenny.

Aster sericeus Vent. Silky aster was collected from 10 loess hill prairies from Bielema and Reavis Spring south to Renault. It was not very abundant at these sites.

Aster turbinellus Lindl. This aster was found in loess and rock prairie at Fountain Bluff. At Government Rock it grew in crevices of rocks, and also in the woodland border, but not in the prairie.

Cacalia atriplicifolia L. Pale Indian-plantain, which grows in a variety of

habitats, open woods, thickets, and prairies, was encountered in loess prairie at four sites and also in coves at two of these places.

Cacalia tuberosa Nutt. This species was seen in loess prairie at Bielema, Balk, Bald Bluff, Swarnes, Sampson, and South Prairie du Rocher.

Chrysopsis villosa (Pursh) Nutt. [*C. camporum* Greene.] Golden aster was found in loess at three sites along the Mississippi and at five along the Illinois River.

Coreopsis lanceolata L. Lance coreopsis was found in rocky soil at Fults; in loess at Reavis Spring, Valmeyer, and Fults; and on rock ledges at Fults and Stotz.

Coreopsis lanceolata var. *villosa* Michx. [*C. crassifolia* Ait.] This variety was found in loess prairie at Valmeyer, Fults, and South Prairie du Rocher.

Coreopsis palmata Nutt. Finger coreopsis occurred in more prairies than the preceding species and variety. It was seen in 11 prairies from Sunset Trail and Standard south to Renault.

Coreopsis tripteris L. Tall coreopsis was seen in loess prairie at Fountain Bluff.

Echinacea pallida (Nutt.) Nutt. Pale coneflower was observed in 18 hill prairies from Bielema and Magnolia south to Cave Creek.

Erigeron annuus (L.) Pers. White-top, or daisy-fleabane, common in fallow fields, prairies, and waste places, was observed in only two hill prairies, Chautauqua and Oblate Fathers.

Erigeron canadensis L. Horse-weed or mule tail, a common weed, was observed in 16 hill prairies.

Erigeron divaricatus Michx. Spreading fleabane was found in a pastured hill prairie, Seehorn-Payson.

Erigeron strigosus Muhl. This fleabane was observed in 40 hill prairies. Possibly it occurred in some of the other prairies that were visited but once during this study.

Eupatorium altissimum L. Tall thoroughwort, common in pastures, rocky hills, thickets, and along roadsides, was observed at 35 sites from Sunset Trail and Magnolia to Cave Creek.

Gnaphalium obtusifolium L. Catfoot, old-field balsam, or sweet everlasting, was observed in 15 hill prairies.

Helianthus divaricatus L. This sunflower of dry woods and thickets was seen in 13 hill prairies, often on the upper slopes toward the crests of the ridges.

Helianthus mollis Lam. Ashy sunflower, common in some upland prairies, was collected from loess hill prairie and the woodland border at Clendenny.

Helianthus occidentalis Riddell. This sunflower was found growing in loess at East Henry and Bunker.

Helianthus rigidus (Cass.) Desf. [*H. laetiflorus* var. *rigidus* (Cass.) Fern.] Prairie sunflower was seen in five hill prairies from Swarnes to Renault.

Helianthus strumosus L. This sunflower was encountered in loess at Southwest Edgemont, Valmeyer, and Renault. At Fults and Fountain Bluff it was found in wooded coves.

Heliopsis helianthoides (L.) Sweet. The scabrous form [var. *scabra* (Dunal) Fern.] of sunflower heliopsis was found in loess at Block House.

Kuhnia eupatorioides L. False boneset was a common species in hill prairie. It was seen in rock and loess prairies from El Rancho and Devil's Backbone to Cave Creek.

Lactuca canadensis L. This wild lettuce was found in loess at four hill prairies. Only a few isolated plants were present at each of these sites.

**Lactuca scariola* L. Prickly lettuce was seen only in the pastured Walnut Creek prairie.

Liatris aspera Michx. This blazing-star or gay-feather was observed in 12 hill prairies from Sunset Trail and Devil's Backbone to Grand Canyon.

Liatris cylindracea Michx. The cylindric blazing-star was collected from loess prairie at North Eldred, Chautauqua, Principia, Block House, Valmeyer, Fults, and Sampson; at Sunset Trail it was observed in crevices of rock ledges.

Liatris scabra (Greene) K. Schum. This species was collected in rock prairie at Cave Creek and Fountain Bluff, where it occurred also in loess prairie and in crevices of the sandstone ledges. At Government Rock (in the type locality for

this species) it was collected in rocky woodlands.

Ratibida pinnata (Vent.) Barnh. Prairie coneflower, common in upland prairie, was found in nine scattered hill prairies.

Rudbeckia missouriensis Engelm. This coneflower apparently is restricted in its range in Illinois to Monroe and Randolph counties, where it was found in four hill prairies, Valmeyer, Fults, Sampson, and Phegley (Evers 1951).

Rudbeckia serotina Nutt.* Black-eyed Susan was found in 12 hill prairies. It was not common at any of these sites.

Senecio pauperculus Michx. This ragwort was found in loess at Sunset Trail.

Senecio plattensis Nutt. Prairie ragweed was found in scattered hill prairies from North Savanna and Reavis Spring to Stotz.

Silphium integrifolium Michx. Rosinweed was found in scattered hill prairies from Fall Creek and East Henry to Cave Creek.

Silphium laciniatum L. Compass-plant was collected in four loess hill prairies, Swarnes, East Henry, Reavis Spring, and North Eldred.

Silphium terebinthinaceum Jacq. This species was found at Valmeyer and Cave Creek. Scattered individuals at Cave Creek can be referred to the variety *pinnatifidum* (Ell.) Gray.

Solidago altissima L. Tall goldenrod was found in eight hill prairies from Wiersma to Tamms.

Solidago canadensis L. This species was found in loess at El Rancho, Sunset Trail, and Wiersma.

Solidago drummondii T. & G. Drummond's goldenrod was found in hill prairie at North Eldred, Chautauqua, Phegley, and Fountain Bluff. It was collected also from crevices in rock ledges at Richwood, Valmeyer, Fountain Bluff, and Government Rock.

Solidago missouriensis var. *fasciculata* Holz. [*S. glaberrima* Martens.] Prairie goldenrod was seen at Principia and Tamms.

*This name was applied by Fernald (1950) to our common black-eyed Susan. He separated it from *R. hirta* L. on the shape of the basal and cauline leaves. The specific name *serotina* is used in this paper although further study of the plant in the field and of herbarium specimens may show it not specifically distinct from *R. hirta* L.

Solidago nemoralis Ait. Field goldenrod was found to be the most abundant goldenrod of the hill prairies. It was observed in 33 loess and rock prairies in Illinois.

Solidago petiolaris Ait. This species was found in cherty prairie at Tamm.

Solidago radula Nutt. Rough goldenrod was found in 15 hill prairies from North Pandarmie and North Eldred south to Government Rock.

Solidago rigida L. Rigid goldenrod, common in flatland prairie remnants, was seen in hill prairie at El Rancho, Reavis Spring, Block House, Valmeyer, Renault, and Government Rock.

Solidago speciosa Nutt. Showy goldenrod was collected from loess prairie at Sunset Trail, Devil's Backbone, and Valmeyer.

Solidago ulmifolia Muhl. Elm-leaved goldenrod, a plant of thickets and open woods, was found in six hill prairies, chiefly in stony soil.

**Tragopogon major* Jacq. [*T. dubius* Scop.] This European species was found in the rock prairie at Devil's Backbone.

**Tragopogon pratensis* L. Goat's-beard was found in loess prairie at Sunset Trail and Oblate Fathers.

Verbesina helianthoides Michx. This crownbeard, usually found growing in dry woods and thickets, was seen in rock prairie at Fountain Bluff and Cave Creek and in loess at Chautauqua and Fountain Bluff.

Verbesina virginica L. White crownbeard, or tickweed, was collected from rock prairie and woodland borders at Cave Creek.

Vernonia baldwini Torr. This ironweed was found in loess at six hill prairies from Sessions and North Eldred south to Sampson.

Vernonia missurica Raf. More generally present in hill prairie than the preceding species, this ironweed was found in 11 loess hill prairies and in some of the adjoining wooded coves.

Three hundred ninety-four species and varieties of plants were found by the writer in the hill prairies of Illinois. Of these, 390 were vascular plants distributed among 209 genera and 70 families. The family represented by the greatest numbers

of species and genera was the Compositae, 71 species and varieties in 26 genera. *Aster* was the largest genus; 12 species were represented. The four species of nonvascular plants included two species of the lichen *Lecidea*, a liverwort, and a moss.

Geographical Relations of the Hill Prairie Flora

The majority of plant species in Illinois hill prairies are presumably of southeastern origin. Three of the important grass species, *Andropogon scoparius*, *A. gerardi*, and *Sorghastrum nutans*, came from southeastern United States.

There are, however, numbers of species characteristic of the western plains and of the Ozark plateau. These are *Bouteloua hirsuta*, *Psoralea tenuiflora*, *Polytaenia nuttallii*, *Asclepias stenophylla*, *Mentzelia oligosperma*, *Salvia pitcheri*, *Plantago purshii*, *Agoseris cuspidata*, *Ambrosia coronopifolia*, *Solidago drummondii*, *Aster anomalus*, and *Rudbeckia missouriensis*.

The last three possibly are from the Ozark plateau. In addition to the plants enumerated above, *Synthyris bullii* may be mentioned as a species, possibly from the Rocky Mountains, that migrated eastward along glacial moraines (Pennell 1935).

SUMMARY

1. Hill prairies are grasslands on pronounced slopes. *Prairies* is here used as a vegetational term rather than a locational or topographic term for an expansive flat.

2. Of the many hill prairies in Illinois, 61, with a combined area of more than 200 acres, were visited by the writer in the course of this study.

3. In Illinois, hill prairies occur on the exposed upper or brow slopes of the generally southwest- and west-facing bluffs east of the Mississippi River for most of the length of the state and on similar slopes along the Illinois River from Putnam County southward into Jersey County, where the valley of the Illinois enters the Mississippi valley. Hill prairies are present also along the Sangamon and Rock rivers.

4. Location and topography exert the strongest controls, or place influences, that

determine the occurrence of prairie on the upper slope of a bluff. The west- to southwest-facing position of the slope, which exposes the slope directly to the hot rays of the afternoon sun and to prevailing southwest summer winds, and the altitude of the bluff and width of the adjacent bottomlands help to provide the extremely xeric conditions under which this type of prairie thrives. Rapid and excessive drainage, due both to slope and to permeable loess substratum, is a reinforcing condition.

5. The vegetation of Illinois hill prairies is the bunch-grass type, with *Andropogon scoparius* the dominant species in most stands. *Bouteloua curtipendula* is usually present, in a few prairies dominant. In a few hill prairies, *Sorghastrum nutans* and a few other bunch grasses occur frequently and may dominate small areas within the prairie, or, rarely, the entire stand.

6. For detailed studies of the vegetation, plots were staked in unpastured and in pastured variants of the same prairie slope. Data were obtained from plot sizes ranging from 1/256 milacre to 9 milacres. The smallest size found to be effective was 1/64 milacre. The largest area staked in each prairie was 75 milacres. One milacre in each prairie—pastured and unpastured—was mapped. All plant individuals were charted and counted in each of these milacres. Species lists were compiled for plots of the several sizes.

7. In the mapped milacre of the unpastured prairie, the estimated number of plants was 1,949; 1,404 of these were *Andropogon scoparius*. In the mapped milacre of the pastured prairie, the estimated number of plants was 1,341; 849 of these were *A. scoparius*.

8. The ground space occupied by plants in the mapped milacre of the unpastured prairie was 1,884.1 square inches, of which 1,781.0 square inches were occupied by *Andropogon scoparius*. In the mapped milacre of the pastured prairie the ground space occupied by plants was found to be 1,403.3 square inches, of which 1,107.0 square inches were occupied by *A. scoparius*. In the unpastured prairie, at ground surface, 69.96 per cent of the mapped milacre was bare

loess; in the pastured prairie, 77.63 per cent.

9. In the mapped milacre of the unpastured prairie, foliage covered 4,988 square inches, approximately 80 per cent of the milacre. In the mapped milacre of the pastured prairie, foliage covered 2,525 square inches, about 40 per cent of the milacre. In both pastured and unpastured prairie, *Andropogon scoparius* was the species with the largest foliage area. In the unpastured milacre, approximately 20 per cent of the ground was not covered by foliage; in the pastured milacre, about 60 per cent.

10. The available space per plant in the unpastured milacre was found to be 3.22 square inches; in the pastured milacre it was 4.68 square inches.

11. For the study of frequency of occurrence of species in plots within hill prairie, a good distribution of species was obtained with quadrat sizes of 1/64 to 1/4 milacre in unpastured prairie; 1/16 to 1/4 milacre in pastured prairie.

12. From species-area curves, the smallest representative area—the smallest one-piece area having some claim to be representative—was determined for the unpastured prairie as 0.76 milacre, and, for the pastured, 1.26 milacres. The minimum area for assignment to type—an area that is large enough to include all the important and a moderate number of minor species—was determined as 3.80 milacres for the unpastured and 6.30 milacres for the pastured prairie. The fair-sized stand—an area that is 50 times as large as the smallest representative area and contains twice as many species—was 38.0 milacres for the unpastured and 63.0 milacres for the pastured hill prairie.

13. The flora of 36 hill prairies was used as a basis for presence studies. The "constants" (species in 29, 80 per cent, or more of the 36 locations) of this type of prairie in Illinois were *Andropogon scoparius*, *Erigeron strigosus*, *Bouteloua curtipendula*, *Petalostemum purpureum*, *Euphorbia corollata*, *Penstemon pallidus*, *A. gerardi*, *Verbena stricta*, and *Kuhnia eupatorioides*. Twenty-five species were found in 18 or more of the 36 prairies used in this study of presence. Species most characteristic of the hill prairie type

(i.e., of much lower presence in other prairie types in Illinois) were *Bouteloua curtipendula*, *Psoralea tenuiflora*, *Petalostemum candidum*, *Linum sulcatum*, and *Lithospermum incisum*.

14. Prairie stands possibly existed on the bluffs that now support prairie from Wisconsin or pre-Wisconsin time to the present. This vegetation will presumably continue to grow on these sites until a change in climate occurs which will provide more mesic conditions, or until advanced erosion of the bluffs forms a continuously gentle slope, or until high cliffs are reduced.

15. The observed flora of Illinois hill prairie was 394 species and varieties. Of these, 390 were vascular plants distributed in 209 genera and 70 families. The largest family was Compositae, with 26 gen-

era and 71 species and varieties. *Aster* was the largest genus, with 12 species. Thirty species were of foreign origin.

16. Although most species of Illinois hill prairie plants are of southeastern origin, nine species are distinctly western or southwestern, and three are from the Ozark plateau. Of these 12 species, *Mentzelia oligosperma*, *Asclepias stenophylla*, and *Rudbeckia missouriensis* are seemingly restricted to hill prairie and adjacent rock ledges.

17. Some prairie slopes are grazed, and some are annually or less frequently burned, yet the prairie persists. As these steep slopes have never been plowed, they represent one of the least disturbed types of prairie in Illinois, and some of them should be preserved.

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